APPENDIX A
Sample Questionnaire and Summary Table

STORMWATER MANAGEMENT, EROSION AND SEDIMENT POLICIES AND CRITERIA STUDY

QUESTIONNAIRE

The Niagara Peninsula Conservation Authority (NPCA) in conjunction with the Regional Municipality of Niagara and its Municipal Members is coordinating a study to develop new stormwater management (SWM), erosion and sediment policies and criteria to be practiced within the NPCA's watersheds.

The objective of this study is to develop a set of comprehensive SWM policies (including erosion and sediment) that reflect a "state-of-the-art" approach to water quantity and water quality management. The need for this approach was identified in the Niagara Water Quality Protection Strategy (NWQPS) as one of the action items that is required to provide an effective approach in the management of water resources within the Niagara Region for the protection and enhancement of water quality.

This study is following a series of steps in the development of SWM policies (including erosion and sediment) and procedures:

1. Review of current practices
2. Summarize existing policies and criteria
3. Compare practices in other jurisdictions and SWM policy trends
4. Identify SWM policy needs and opportunities for policy improvements
5. Identify and compare alternatives for changes to SWM policies and procedures
6. Develop recommended approach for SWM policies and procedures.

This questionnaire is part of the first step in this study to identify current practices of the Municipality within the watersheds of the NPCA. We ask that you fill out this questionnaire and return it to **Tony D'Amario** as noted at the bottom.

You will be notified of future meetings where you will have the opportunity to attend and participate further in this project.

1. Name: _____

2. Municipality represented: _____

3. Which of the following do you practice with respect to SWM for development review purposes?
   - Formal (published) SWM policy procedures manual for SWM _____
   - Follow SWM policies and procedures but not in a manual _____
   - Rely on other agencies for SWM requirements (NPCA or Region) _____

4. If you have a SWM manual, was it approved by council? Yes_____ No _____

5. Do you have policies for SWM in areas of infill or redevelopment (where infrastructure currently exists? If so, please specify Yes_____ No _____

_____

_____

_____

6. Do you refer to or use the MOE guidelines for stormwater management? (MOE, 2004) Yes _____ No _____

7. If you specify SWM requirements does it include the following?

		Yes	No
a.	quantity control (peak hours)	_____	_____
b.	quality control	_____	_____
c.	meets infiltration targets	_____	_____
d.	flow control to control erosion	_____	_____
e.	other (specify)	_____	

8. Do you specify any particular targets to be met in the SWM requirements outlined in question 6? If so, what are they (in general)?

_____

_____

_____

9. Do you have technical (or design) guidelines for use in drainage and SWM design (i.e. design event, methods of calculation etc). If so what?

_____

_____

_____

10. Do you see agree that there is a need to update or develop new SWM guidelines? If so, what do you see as the benefits for this?

_____

_____

_____

11. Do you currently have a SWM maintenance and inspection program in place? Yes _____ No _____

12. Do you see the need for municipalities to have a SWM maintenance and inspection program? Yes _____ No _____

13. Do you wish to participate in future meetings for this study? Yes _____ No _____

14. Do you have any relevant guidelines, and if so, can you please forward a copy? Yes _____ No _____

15. Further comments

_____

_____

_____

Please return to:
Tony D'Amario, P.Eng.
Niagara Peninsula Conservation Authority
250 Thorold Road West; 3rd Floor
Welland, ON L3C 3W2
Phone: 905-788-3135 ext. 232
Fax: 905-788-1121
Email: tony.damario@conservation-niagara.on.ca

Stormwater Management, Erosion and Sediment Policies and Criteria Study
Questionnaire

		Responses													
	Questions	John Morgante City of Hamilton	John Kukalis, Director of Public Works Town of Lincoln	Nick Aragona, Deputy Director Public Works Town of Niagara On The Lake	Bob LeRoux Town of Grimsby	David Farley Niagara Region	Tim Marotta, Simon Leung City of St. Catharines	Rick Volpini, C.E.T., Development Technologist City of Niagara Falls	Ron Hanson, C.E.T. Manager, Engineering Services City of Port Colborne	L.J. Hodge Town of Pelham	Ron Scheckenberger West Lincoln	Lino Ventresca City of Welland	Ron Scheckenberger Haldimand County	Robert Judd Town of Fort Erie	Adele Arbour City of Thorold
3	Which of the following do you practice with respect to SWM for development review purposes?														
	- Formal (published) SWM policy procedures manual for SWM	- City of Hamilton Storm Drainage Policy, May 2004	X	X	Yes (Town, MOE, MNR)	X		MOE Design Manual		MOE Stormwater Management Planning & Design Manual (March 2003)	December , 1990		X (Rev. June 2005)	X	
	-Follow SWM policies and procedures but not in a manual				No	X	yes		X		Both		X (not sure of the questions intent)		
	- Rely on other agencies for SWM requirements (NPCA or Region)		X	Region and NPCA also comment on requirements and review the submitted designs	No	Partner with NPCA					Indirectly	Yes	X (mainly GRCA)		NPCA & Region
4	If you have a SWM Manual, was it approved by council?	Policy was, the Criteria and Guidelines was not	Yes	N/A	No	No	No	No Manual	No	No	Yes		No - pending	Yes	
5	Do you currently have policies for SWM in areas of infill or redevelopment (where infrastructure currently exists) If so, please specify	Yes. Cash-in-lieu policy when on-site swim is not possible. City is developing a Master Stormwater Quality Plan to identify retrofit locations. A pilot study has bee prepared for the former community of	Yes - quantity - peak control of minor system events to system allowance, quality - best efforts only	No. We require that the applicant conform to the design parameters of the existing infrastructure. If they cannot conform to that e design AR for the property additional onsite controls would be required. In addition the development would be assessed for onsite quality	Yes. SWM Quantity as per MDP, Quality on-site or cash-in-lieu	The Region uses the MOE SWM Guidelines and employs them where appropriate	No	Yes - If applicable, MOE guidelines are applied. Not applied to smaller in-fills (i.e. single lots)	Yes - Lot grading policy and procedures	No	No	No - no written policy but require to design to pre-development flows in order not to impact existing infrastructure	Yes - Work in progress., cast-in-leiu particularly on site SWM is identified	Yes - See #4	No
6	Do you refer to or use the MOE guidelines for stormwater management (MOE, 2004)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes (in review comments - not manual)	Yes	Yes	Yes	No
7	If you specify SWM requirements does it include the following:														
	a. quantity control (peak hours)	Yes - minimum post=pre unless other studies provide direction otherwise, also infrastructure flow capacity reviewed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
	b. quality control	No - required but site specific	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No - predates 1991 (only some techniques)		Yes	Yes	
	c. meets infiltration targets	No - required but site specific	No	Yes	No	Yes	Yes	Yes	No	Yes	No - predates 1991 (only some techniques)		Yes- none set, indirectly only (site specific assessment required)	No	
	d. flow control to control erosion	No - required but site specific	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes - indirectly		Yes	Yes	
	e. other (specify)			Pond shape and side slopes				Maintenance Schedule			Major/minor systems		Major/minor systems		
8	Do you specify any particular targets to be met in the SWM requirements outlined in Question 6? If so, what are they (in general)?	No, SWM targets based on watershed, subwatershed studies etc. (including RAP)	Typically, specific SWM targets are tied to local Maps or other local drainage/erosion studies	The development must design to predevelopment flow rates	Yes - peak flow, enhanced water quality, erosion thresholds	MOE guideline targets	No	Only those as specified in the MOE document		No	Watershed-based, not general or generic	No	Yes - Quantity 2-100yr (flooding), 25mm (erosions), MOE 2003, Enhanced, Normal, Basic	Quality control as per NPCA/MOE requirements. Quantity control to pre-development rates for the 5yr to 100yr storm. Must control to 2yr storm if capacity of downstream outlet is restricted	
9	Do you have technical (or design) guidelines for use in drainage and SWM design (i.e. design event, methods of calculation etc.). If so what?	Draft guidelines for hydrologic modelling, design events and stormwater management design requirements (flood, erosion and quality management)	Specific design storms (2-100yer); however it would be preferable to have them updated as they were derived in late 1980's	We are currently working g on a "Municipal Engineering Standards" manual which will include SWM guidelines. We are also in the process of adopting a municipal policy in regard to landscaping of SWM facilities	Draft Storm Drainage Policies & Criteria Manual, existing Master Drainage Plans	MOE guideline targets	No	Have used MIDUSS program on occasion	Pre/Post Quantity control. Design event based on density of development	City of Welland IDF curves and rational method. For greater than 5 year events use hydraulic modelling (i.e. MIDUSS, SWMM, OTTHYMO	Runoff analysis section in Policies and Criteria	No	IDF Cuves only	Yes, Town Guidelines and MOE guidelines	
10	Do you agree that there is a need to update or develop new SWM guidelines? If so, what do you see as the benefits for this?	Yes. Municipalities will have an update to SWM and erosion guidelines for NPCA's jurisdiction. This would complement City of Hamilton's SWM Policy and Draft SWM Guidelines	Yes but subject to comments under Question 15	Would prefer to have uniform guidelines within the Region or Conservation Area	Yes - standardized criteria, with local issues addressed	This review (study) should provide a more consistent approach to SWM as well as identify those management techniques that are more beneficial than others	No	If there are requirements above and beyond the MOEE guidelines, then the Niagara area should develop a common standard		No	Township requires and update, region-wide/watershed-wide consistence, good for development community consistency/understanding, good for watershed protection	Yes. Detailed guidelines will provide better long-term designs and uniformity throughout. Provide requirements to developers upfront creating more efficient designs, construction and maintenance	Municipal guidelines are current. NPCA guidelines should be a complement and allow for independence.	Our guidelines are recent, a review and update may be needed in 5 years.	Yes - consistency through the Region
11	Do you currently have a SWM maintenance and inspection program in place?	Yes - partial	Yes		No	No	Yes	Yes	No	Yes	Yes - informal only	No	Yes - informal only	Yes	No
12	Do you see the need for municipalities to have a SWM maintenance and inspection program?	Yes	Yes	Yes. We have established a budget for 2005, however we have not implemented any work or schedule to date	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
13	Do you wish to participate in future meetings for this study?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
14	Do you have any relevant guidelines, and if so, can you please forward a copy?	Yes - City of Hamilton SWM Policy and Draft SWM Guidelines - NPCA has a copy of each already	No	No	Yes		No	No	No	Yes	Yes - December 1990	No	Yes - June 2005	Yes - will email Tony	No
15	Further comments:		There are enough general guidelines (i.e. that simply tell you to complete a detailed study) and best practice documents currently available from MNR, etc. Practical design oriented information that will assist in expediting the design process for small and medium risk/size projects is totally lacking and would be of most use (e.g. peak flow equations, simplified hydrograph techniques, etc.)			For question 14 - Refer to MOE SWM Guidelines 2004	A SWM maintenance and inspection plan is absolutely necessary since the device/system won't function properly if not maintained.			To save time and avoid reinventing the wheel, recommend that all Niagara Municipalities and NPCA adopt MOE manual		Currently our municipal engineering standards for residential subdivision development only requires that a stormwater management report is required. No detailed technical requirements.	Refer to webstie for design criteria.	Please advise/notify of any project team meetings.	

APPENDIX B
Summary of all Documents

Summary of Official Plans, SWM Policies, Design Guidelines and By-laws within the NPCA Watersheds		Date
Title of Document		
General		
Working Document, Erosion & Sediment Control Guidelines for Urban Construction, Draft 3		July, 2005
NPCA Groundwater Study Final Report		October, 2005
Niagara Water Quality Protection Strategy		Spring 2005
Niagara Escarpment Commission - Niagara Escarpment Development Control Areas		
Regional Municipality of Niagara		
Regional Niagara Policy Plan		January 2004
Amendment 187 - Section 7 Environmental Policies		2005
Regional Municipality of Niagara Environmental Impact Study Guidelines		March, 2001
Regional Municipality of Niagara Sewer Use Bylaw No. 39-2002		
By-law to Prohibit or Regulate the Harvesting, Destruction or Injuring of Trees - By-law No 47-2006		2006
Model Site Alteration By-law for the Niagara Community		August 2004
Regional Municipality of Niagara Model Urban Design Guidelines		
City of Hamilton		
City of Hamilton, Criteria and Guidelines for Stormwater Infrastructure Design, Draft		December, 2004
Site Alteration By-law		
City of Niagara Falls		
City of Niagara Falls Official Plan		
The City of Niagara Falls, Draft, Subdivision Development Standards & Procedures Policy		
The City of Niagara Falls Canada Development Guide 2004		January, 2004
The City of Niagara Falls Canada, Subdivision Development Standards & Procedures Policy - Draft		
By-law to prohibit or regulate the placing or dumping of fill, the removal of topsoil and the alteration of the grade By Law - 2004-57		2004
By-law to regulate the maintaining of land in a clean and clear condition - By-law No. 2000-249		1996
By-law to Prohibit or Regulate the Destruction, Injuring or planting of Trees - By-law No 2004-173		2004
By-law for prescribing the standards for the maintenance and occupancy of property - By-law No. 2000-091		1998
City of St. Catharines		
City of St. Catharines Official Plan		
City of St. Catharines, Storm Drainage Manual		July, 1992
By-law to regulate sanitary and storm drainage		1997
City of Thorold		
City of Thorold Official Plan		2005
By-law for prescribing the standards for the maintenance and occupancy of property - By-law No. 13-2000		2005
City of Welland		
The Corporation of the City of Welland, Municipal Engineering Standards, For Residential Subdivision Development, Engineering Department		April, 1998
The Corporation of the City of Welland Bylaw 9973 - Site Plan Control		2001
The Corporation of the City of Welland Bylaw 2002-1 - Standard Subdivision Agreement		April 4, 2002
City of Welland, Strategic Priorities for Implementation		January, 2004
Haldimand County		
Haldimand County Official Plan		June 26, 2006
Haldimand County, Design Criteria		January, 2003
By-law to prescribe standards for the maintenance and occupancy of property		2006
Town of Fort Erie		
Town of Fort Erie Official Plan		
Town of Fort Erie, Subdivision Control Guidelines for Development of New Subdivisions & Application Form		June, 2004

Town of Fort Erie Site Plan Control - Processing Guidelines and Application Forms		2003
Town of Fort Erie Subdivision Control - Guidelines for Development of New Subdivisions & Application Form		June, 2004
Town of Fort Erie - Fill and Site Alteration By Law 201-96		1996
Town of Fort Erie - Regulate the management of a system of sewer works and drainage works By Law 68-06		2006
Town of Fort Erie By-Law 60-04 - Harvesting of Trees		2004
The Corporation of the Town of Fort Erie Stormwater Management Facility Design, Operation and Maintenance Policy and Standards		
The Corporation of the Town of For Erie Lot Grading and Drainage Policy		1992
Town of Grimsby		
Town of Grimsby Official Plan		
Town of Grimsby, Storm Drainage Policies and Criteria		
Town of Grimbsy Site Plan Application		
Town of Lincoln		
Town of Lincoln Official Plan		May, 2006
Town of Lincoln, Municipal Design Standards		
By-law to prohibit or regulate the placing or dumping of fill and the alteration of the grade of land - By-law 99-43		
Town of Niagara on the Lake		
Town of Niagara on the Lake Official Plan		
Town of Niagara on the Lake Policy - Landscape & Maintenance Guideline for SWM Ponds & Facilities		April 11, 2006
By-law to prohibit or regulate the removal of topsoil, the placing or dumping of fill and the alteration of the grade of land - By-law 3941-05		
By-law for prescribing the standards for the maintenance and occupancy of property - By-law No. 3681-02		
Town of Pelham		
Town of Pelham Official Plan		Recently updated, not public yet
Town of Pelham - Application for Subdivision or Condominium Approval		
Town of Pelham - Site Plan Agreements		
The Corporation of the Town of Pelham - By-law removal of topsoil		
Town of Port Colborne		
City of Port Colborne New Official Plan		2006
City of Port Colborne New Official Plan - Urban Design Issues and Options Background Paper		
By-law for prescribing the standards for the maintenance and occupancy of property - By-law No. 4299/135/02		2002
City of Port Colborne New Official Plan - Natural Environment Issues and Options Background Paper		
City of Port Colborne Site Plan Control Application		
Town of Wainfleet		
Corporation of the Township of Wainfleet Official Plan		
By-law for prescribing the standards for the maintenance and occupancy of property - By-law No. 059-2000		2000
Town of West Lincoln		
Official Plan of the Township of West Lincoln		June 16, 1998
Strategic Growth Management Plan Township of West Lincoln		

Summary of Official Plans, SWM Policies, Design Guidelines and By-laws In Other Jurisdictions	
Title of Document	Date
City of Windsor	
City of Windsor Official Plan, Volume I, Infrastructure	
City of Windsor Official Plan, Volume I, Procedures	
City of Vancouver	
City of Vancouver, Bulletin 2002-002-EV, Erosion & Sediment Control, Small Lot Development (Less th	April, 2002
City of Vancouver, Bulletin 2002-003-EV, Erosion & Sediment Control, Large Lot Development (More th	April, 2002
City of Vancouver, Bulletin 2000-055-EV, Automotive Dismantlers and Parts Recyclers	January, 2000
City of Vancouver, British Columbia, Sewer and Watercourse By-Law No. 8093	January, 2006
Engineering Specifications, Schedule H to Bylaw 7452, Subdivision Bylaw	February, 2004
City of Vancouver Country Lanes	
City of Vancouver Memorandum, Appendix A-Structural Soil Report	April, 2003
City of Cambridge	
City of Cambridge, Stormwater Management Policies and Guidelines	May, 1997
City of Mississauga	
City of Mississauga, Development Requirements Manual	January, 2002
City of Mississauga, Mississauga Development, Charges Update, Storm Drainage Component	1999
City of Mississauga, Subdivision Requirements, Section 2 - Design Requirements	January, 2002
Town of Halton Hills	
Town of Halton Hills Official Plan, Draft	May, 2005
Town of Halton Hills, Department of Engineering and Public Works, Stormwater Management Policy	April, 2002
Draft Town of the Halton Hills Official Plan - Part C Environmental Management	
City of Chilliwack	
City of Chilliwack, Policy and Design Criteria Manual for Surface Water Management	May, 2002
Design, Construction and Maintenace Process for Stormwater Source Controls	2005
District of Sooke	
District of Sooke Bylaw No. 65, Subdivision and Development Standards Bylaw	2003
The Corporation of the City of Kitchener	
The Corporation of the City of Kitchener, Stormwater Management Policy Development, Final Report	Decemeber, 2001
City of Kitchener, Licence, Chapter 588, Snow Disposal Site	January, 2005
City of Waterloo	
City of Waterloo, Laurel Creek Watershed Development Monitoring Program	Decemeber, 1999
City of Waterloo Stormwater Managmement Guidelines	
The Corporation of the City of London	
The Corporation of the City of London, Environmental & Engineering Services Department	October, 2003
Drainage Bylaw - WM4	July, 2003
The Corporation of the City of London Storm Sewer	December, 2005
The Corporation of the City of London Stormwater Management Pond Requirements	October, 2003

Summary of Official Plans, SWM Policies, Design Guidelines and By-laws In Other Jurisdictions		
City of Edmonton		
City of Edmonton, Design and Construction Standards, Volume 3 Drainage		March, 2004
City of Edmonton, Design and Construction Standards, Volume 3 Drainage, Chapter 3		March, 2004
City of Edmonton Bylaw 11505 - Surface Drainage Bylaw		August, 2001
City of Edmonton Drainage Services Master Plan 2004-2014 Implementation and Strategies		January, 2004
Implementation Plan for a New Drainage Utility		April, 2002
City of Edmonton New Utility Fee for Parking Lots		
Stormwater Quality Strategy		
City of Edmonton's 2006 Environmental Strategic Plan		2006
Office of the City Clerk Sewers Bylaw - Bylaw No. 9425		December, 2004
The Corporation of the City of Burlington		
Storm Sewer Discharge By-Law 86-2002		
City of Toronto		
Toronto Official Plan		June, 2006
Town of Caledon		
Town of Caledon Development Standards, Policies & Guidelines		January, 2006
Town of Oakville		
Town of Oakville Development Engineering Procedures and Guidelines Manual		May, 2005
Town of Oakville Erosion and Sediment Control Guidliens for Private Developments		
City of Pickering		
Fill and Topsoil Disturbance By-law		
District of Muskoka		
Office Consolidation of the Official Plan of the Muskoka Planning Area		April, 2006
Town of Markham		
Bylaw 2006-97		
Town of Innisfil		
Site Plan Application and Guide		
Town of Collingwood		
Site Plan Control Manual		September, 2006
City of Owen Sound		
Site Plan Submission and Approval Guidelines		January, 2004
City of Guelph		
City of Guelph Official Plan 2001, Section 3 - General Development		January, 2005
City of Guelph Official Plan 2001, Section 4 - Municipal Services		January, 2005
City of Vaughan		
OPA 600		August, 2000
Town of Richmond Hill		
Standard Operating Procedures		April 2006
Bradford West Guillimbury		
Design Criteria Manual		February 2006

APPENDIX C
Stormwater Management Policy and Design Guidelines Comparison Summary

SWM Policy and Standards Summary For Municipalties within the NPCA Watersheds

	Town of Grimsby	City of Niagara Falls	City of St. Catharines	Town of Welland	Town of Fort Erie	Town of Lincoln	City of Hamilton	Haldimand
Drainage Infrastructure Planning	Class EA, Planning Act, SWM Plans, and Master Drainage Plan.		- Master Drainage Plan and requirements. - Previous drainage studies.					Comply with Watershed/Subwatershed Planning/Subwatershed Impact Study
Water Quantity Control Targets	Reference to Stormwater Management Planning and Design Manual (MOE, 1999).	Reference to Stormwater Management Planning and Design Manual (MOE, 1999).	Set by Master Drainage Plan.		Quantity & Quality control as per the Director of Public Works or the Stormwater Management Planning and Design Manual (MOE, 1999)	- Stormwater Management Planning and Design Manual (MOE, 1999). - Master Drainage Plan.	New developments and redeveloping areas must assess impacts on local and regional flooding.	Comply with Watershed/Subwatershed Planning/Subwatershed Impact Study.
	"Zero increase in peak runoff policy".						Comply with Subwatershed plans.	Otherwise pre/post, can model to show that additional flow may not cause downstream detrimental effects.
	Specific to Watershed, Subwatershed, and Master Drainage Plan.							Any deviation to be supported with detailed analysis.
	Where no Master Drainage Plan exists, the Town's policy is to require pre-hydrological flows are equal to post hydrological flows.							
Water Quality Targets	MOE (enhanced, normal, and basic).	Reference to the Stormwater Management Planning and Design Manual (MOE, 1999).	Reference to the Stormwater Management Planning and Design Manual (MOE, 1999), NPCA, and MNR.		Reference Stormwater Management Planning and Design Manual (MOE, 1999) or as per the Director of Public Works.	- Stormwater Management Planning and Design Manual (MOE, 1999). - Master Drainage Plans.	Reference Stormwater Management Planning and Design Manual (MOE, 1999) or other existing studies.	Reference Stormwater Management Planning and Design Manual (MOE, 1999) for all new development.
	Water Management Policies, Provincial Water Quality Objectives						Downstream fish habitat.	Downstream fish habitat.
	NWQPS							
Cash-in-Lieu/Redevelopment and Infilling	Provisions for water quality on a site specific basis.				- Redevelopment and infilling will be required to submit a lot grading plan and grading performance deposit at the time of building permit application - The grading performance deposit will be returned upon completion of the grading certificate.		Cash-in-lieu to be used off site where it would be more effective. If the receiver is a low sensitivity, limited rehabilitation opportunity small or infill development.	Where redevelopment is proposed, provisions for water quality control will be on a site specific basis.
	Feasibility of implementation.						To calculate the rate, will need to determine the impacts on water quality and quantity.	Areas where prepared and approved Subwatershed Plans exist, the guidelines and criteria will be adopted by the development proponent.
	May consider cash-in-lieu policies.						Consider for small or infill development, low sensitivity reciever. Limited rehabilitation opportunity apply for cash-in-lieu.	
	Funds to be transferred to priority retrofit sites.							- Cash-in-lieu for off-site improvements. - How easy to implement.
	- Provisions for water quality measures will be evaluated on a site specific basis. - Master Stormwater Quality Plan (to identify sites and reprioritize.							- Master Plan approach to compensation towards off-site works is advocated.
Watercourse Erosion	Adaptive Management of Stream Corridors in Ontario 2001.		Maintain natural watercourses.				In accordance with Watershed/Subwatershed Plans.	Provide protection in accordance with studies.
	Requirements through upper level studies.						NPCA policies.	Other policies.
	Extended detention storage.						If no studies, apply Provincial guidelines.	Extended detention storage for the 25mm storm by MOE if there are no other studies.
	Critical flow values.						Can use modelling to show there will not be negative effects.	Assessment of downstream erosion susceptibility and critical flows using event based modelling.
	Erosion critical velocity or shear forces						Extended detention storage.	
							Assessment of critical flow values.	Assessment of downstream critical velocity and shear forces in conjunction with continuous simulation modeling (duration analysis).
							Critical velocity or shear force.	
							MNR Natural Hazards Technical Guidelines (MNR 2003).	
Rainfall/Design Storms		IDF curves for Niagara Falls or Chippawa.	IDF curves for St. Catharines	Rainfall Intensity using City of Welland IDF curves	IDF Curve data.		IDF Curves for Hamilton.	IDF Curves.
		Meet with City staff prior to design to establish appropriate methodology.	Use the SCS 24hr Type II for designing storage facilities.				Database of design storms and temporal distributions.	
			Use the SCS 24hr Type II for rural watersheds.				Historic rainfall data (airport/RBG).	
			3 hour Chicago distribution, r = 0.46				AES, Chicago, SCS, and AES 1 hour.	
			Huff Distribution (2nd and 3rd quartiles)				Select based on drainage area.	
			Canadian 1 hour for urban areas (2-10 years).				City to approve the temporal distribution.	
			Real storms with flow data to calibrate models.					
Hydrologic and Hydraulic Computations	Provides some specific design guidance to be used in conjunction with the Stormwater Management Planning and Design Manual (MOE, 1999).	Use of zoning information for selecting runoff coefficients.	Rational method for storm sewers.	Rational method	Rational Method		Rational Method	Rational Method
	Provides runoff coefficients, catchbasin spacing, and minimum velocities.	Hydraulics, "n" values, minimum pipe sizes, and minimum depth.	Storage facilities, Chicago, 1 hour design storm, HUFF, SCS 24 hour Type II.	Provides design parameters.	IDF Curve data.		Event based models	Design criteria for storm sewers.
			Real storms in conjunction with flow monitoring to calibrate models.		Runoff coefficients.		Flood Plain Management in Ontario Tech Guidelines (MNR, 2001)	
			Provides design parameters.		Tc - using airport method for large areas.		Drainage Management Manual (MTO, 1997)	
					Tc - 10 min for residential areas.		Sensitivity analysis	
							Calibration	
							Continuous Models	
Rural Subwatersheds			SCS 24 hour Type II					
			Real storms in conjunction with flow monitoring to calibrate models.					
			3rd quartile huff distribution.					
Minor System	5-year	Minor system: 5-year	1:5 year storm	Minor system: 2-year	Minor system: 5-year		5-year	5-year frequency period
								10-year for some commercial areas at discretion of the engineer.
Major System	100-year	Major system: 100-year	1:100 year	Major system: 100-year	Major system: 100-year		100-year storm event	100-year
Hydrogeological Sensitive areas	Provide site specific soils investigations.						Provide site specific soils investigations	Groundwater contamination to be considered especially with road water
	In the absence of studies, contamination potential shall be addressed and monitoring required.						In the absence of studies, contamination potential shall be addressed and monitoring required.	
Spill Management	For all industrial and commercial that process, store, or refine liquid.						For all industrial and commercial that process, store, or refine liquid.	
Centralized Systems	Centralized systems.							
Foundation Drains	Connected directly to storm sewer.	Single family residents to be directed to grade if soils are conductive.	Can be connected to storm drain if basement is above the HGL of the sewer.	Connections to storm drains are prohibited.	Foundation drains may be connected to foundation drain collectors, storm sewer or discharged to the ground. For new development, the foundation drains must be pumped to the sewer and not by gravity.	Gravity connections not normally permitted.	Connect to storm sewer, but must provide good reason. Provide hydraulic analysis for connection.	Direct connection to storm sewer not permitted.
		Row or townhomes can be connected to the storm sewer.		Sump pumps are to be discharged to grade (in a manner that won't cause erosion or inconvenience to the neighbour).			Third pipe approach.	
Roof Leaders	Connection to storm sewer prohibited.	Connection to storm and sewer prohibited.	To be discharged to grassed or garden areas.	Connections to storm drains are prohibited.	Connections to storm drains are prohibited.		Disconnect roof leaders unless specific constraints exist.	- Disconnect where able. - Direct to splash pads.
		Drain to pervious surfaces wherever possible.	Commercial and other can discharge to storm sewer using controlled release devices.	Direct to pervious areas with splash pad.				
Rear Yard Catchbasins	- Municipality may maintain through the use of easements. - Could be deemed private and maintained by the landowner. - Maximum of 6 backyards to drain to rear yard swale. - Policies relating to drainage between homes and roof water drainage.				Can be installed to drain rear yard swales and provides the maintenance easement specifications.			
Combined Sewers				Connecting to an existing combined sewer or road side ditch may be used as a storm sewer outlet subject to approval from the City and MOE.				

	Town of Grimsby	City of Niagara Falls	City of St. Catharines	Town of Welland	Town of Fort Erie	Town of Lincoln	City of Hamilton	Haldimand
Storm Outfalls	Designed to prevent erosion prevent access by public require permit from NPCA.	Outlets to be designed to dissipate energy to not cause erosion.	Protected to prevent children from entering.	Contact NPCA to ascertain permits.	Designed to prevent erosion.			Appropriate bank scouring protection.
		Supported with design calculations.			Aesthetically pleasing.			Drop structures for steep valleys.
	Require permit from NPCA.				Prevent public from entering the pipe.			Cannot interfere with natural channel forming processes.
					Outlet velocities not to be erosive.			
					Above normal water level.			
					Approach/angle with flow.			
					Dynamic beaches and potential obstruction considerations.			
					MNR Natural Hazard Technical Guidelines (MNR, 2003)			
Natural Watercourse Treatment	Adaptive Management in Stream Corridors (MNR, 2001)	Alterations must satisfy City and NPCA.	Stabilize eroding areas by appropriate measures .	NPCA			MNR Natural Hazards Technical Guidelines (MNR, 2003)	Where control of flow is not feasible or ineffective, design of channel alterations may be considered.
	NPCA/DFO permits.		If development will increase erosion downstream, developer must prevent further damage.	Department of Public Works			MNR Adaptive Management of Stream Corridors in Ontario (MNR, 2001)	Design According to Natural Channel Design Principles (1994)
	Accommodate fish compensation strategies.			St. Lawrence Seaway Authority			Permits from NPCA and DFO.	
			Approvals through MNR and NPCA.				DFO compensation.	
			Erosion control measures must preserve natural valley aesthetics.				Incorporate requirements of ESAs, Niagara Escarpment, and Heritage Sites.	
			Protection could be required to the 1:100 flood level.				Consider maintenance requirements (i.e., utilities).	
							Multidiscipline	
							Design approach	
							Guidelines such as MNR, Rosgen, Annable, and Newbury.	
							Design documentation.	
Hazard Lands and Setbacks	"Land use policies for Valley Lands".		Stay out of 1:100 year floodlines.					Development proponent must to delineate floodplains in a proposed development
								Resulting from the 100-year and Regional Storm for pre and post conditions.
Lot grading criteria			- Provides general guidelines and minimum slopes for rear yard swales. - No mention of maintenance easements.	- Lot grading and drainage policy. - Provides guidelines for subdivision lot grading, maximum and minimum swale slopes and lengths.	- Lot Grading and Drainage Policy (1992) - Covers subdivision agreement, site plan control, and redevelopment.		- Reduced lot grading not endorsed. - City of Hamilton Engineering Guidelines (City of Hamilton, 2003).	
Reverse Driveways			Not to be connected to the storm sewer unless above HGL.	Not permitted.				
SWM and Passive Recreational Opportunity	Consider potential integration with recreational uses.						Consider potential integration with recreational uses.	
SWM Facility Design and Landscaping Guidelines	As per the Stormwater Management Planning and Design Manual (MOE, 1999).	Lists criteria for pond design.			- By-law No. 110-05. - SWM facility design, operation and maintenance policy and standards.		Lists criteria for pond design.	
		Fencing is not required around ponds with slopes less than 3:1.						
BMPs	List potential BMP alternatives.		- Lists appropriate SWM BMPS - grass swales, ponds, roof leaders to grass, rooftop storage, and underground storage. - Policy permits temporary detention facilities within watercourses.	SWM detention through roof top storage, parking lot detention, oversized pipes, and green area detention.	Lot level controls, conveyance and end-of-pipe.		Provides lists of the three category BMPs.	Reports must contain a statement by the designer indicating that BMPs were reviewed and utilized.
	Pro-active techniques are considered first. Apply at the source.						Limited opportunity.	
	1) Lot level techniques and source control.						Limited information on impacts of stormwater infiltration.	Maintenance of hydrologic cycle is encourage where soil conditions permit.
	2) Transport or Conveyance control.						Application of a BMP should be considered in Subwatershed Study or local Master Plan.	SWM facilities to enhance or maintain infiltration.
	3) End-of-pipe						Pro-active techniques are considered first. Apply at the source.	Active infiltration measures will be applicable with supporting soils information.
	Highlights the fact that SWM BMPs are more effective at the source.						1) Lot level techniques and source control.	Apply BMPs at the source.
							2) Transport or conveyance control.	Endorses Provincial Standards for SWM.
							3) End-of-pipe	Lists various BMPs for the 3 categories.
								1) Lot level techniques and source control.
								2) Transport or conveyance control.
								3) End-of-pipe
Operation and Maintenance	Operation and Maintenance manual requirements.				- All SWM reports must contain a maintenance schedule for sediment removal. - Policy provides some standard maintenance activities and frequency.		Operation and Maintenance manual requirements.	
Erosion and Sediment Control	Guidelines on Erosion and Sediment Control for Urban Construction Sites (MNR, 1987)	Minimize both site and downstream erosion.	Guidelines on Erosion and Sediment Control for Urban Construction Sites (MNR, 1987)	Submit a sediment and erosion control plan according to MOE, MNR, and MTO design guidelines.	In accordance with Guidelines on Erosion and Sediment Control for Urban Construction Sites (MNR, 1987).		Ontario Guidelines on Erosion & Sediment Control for Urban Construction Sites 1987	Ontario Guidelines on Erosion and Sediment Control for Urban Construction Sites (1987)
	Keeping Soils on Construction Sites (Hamilton Conservation Authority and Halton Region Conservation Authority, 1994)	Minimize silt and water quality impairment.			Maintain silt traps.		Provides a list of options.	Provides a list of measures to consider.
Submission Requirements	Pre-consultation		Draft plan of subdivision.	Meet with City prior to design.	Compliance with MOE and MNR.		"What is a Complete Submission".	Storm drainage plans.
	Preliminary SWM submission.		Site plan developments.	Consultant experienced in SWM design.	Meet with City prior to design.		Design storms.	External areas (e.g., scales).
	Final SWM submission.		Sites with no on-site collection.	Pre-design meeting with consultant.	Flooding, erosion, and water quality.		Reporting structure.	Internal drainage plans (required details).
			Sites with on-site collection.	City to review final SWM report to ensure adequate.	SWM facilities.		Completed Master Planning (Watershed/Subwatershed).	
			How Master Drainage Plan criteria are met.	Technical review of SWM report by MOE.	Plans showing lot level controls, conveyance controls, and end-of-pipe facilities.		SWM Plans (Functional and Detailed design).	
			Hydrologic model used (with assumptions and limitations).	Post and Pre-development drainage patterns for minor and major events.	Pond cross-sections.		Permit applications.	
			Major and minor systems.	Discuss Master Drainage Plan.	Detail grading.		Existing studies.	
			Degree of detention from Master Drainage Plan.	Discuss standard BMPs and reasoning behind selection.	Storage capacity and rate of discharge.		Approved models.	
			Specifies submission requirements.	Discuss hydrologic model, limitations, and parameters used.	Flow control details.		Design sheets.	
				All calculations to be submitted on disc (i.e., flow calculations, pollutant loading removal, and stage-storage discharge).	Landscape plans.		E and S control inspection report.	
				Plans showing limits of major ponding areas.			Site alteration By-law.	
Basement Flooding			Backwater prevention valves.					
			Proper grading and design.					
Approvals		City of Niagara Falls development team (identifies departments).			MOE "COA".			
					Director of Public Works.			
					Region of Niagara Planning and Development Department			
					NPCA			
					Region of Niagara Public Works Department			
SWM Monitoring	Apply adaptive management techniques.						Prior to, and after assumption.	
							Monitor.	
							Apply adaptive management techniques.	
Types of Monitoring Plans							1) Stand alone.	
							2) Master Planning Document (Watershed Plan, Subwatershed Plan, and Class EA).	
Maintenance Protocol - Public Facilities					By-law - SWM facility design, operation and maintence policy and standards.			
Maintenance Protocol - Private Facilities								

APPENDIX D
Official Plan Comparison Summary

Appendix D: Summary of Stormwater Related Policies for Municipalities within the NPCA Watersheds

Official Plan Name	Date	Source Water Protection	Watershed Planning	Secondary Planning / Neighbourhood Control Plans	Hazard Land Policies	Transportation	Development Application/SWM Requirements Sediment & Erosion Control	Servicing	Combined Storm and Sanitary	Municipal Drains
Official Plan	•unknown	•Hydrogeologic studies to ensure future development does not impact ground and surface water quality and quantity	•Undertake watershed and subwatershed planning in areas of urban development pressure and areas where significant environmental concerns have been identified •Work with conservation authorities, provincial ministries, neighbouring municipalities, and County •Establish and Achieve water Quality and Quantity objectives	•n/a	•Riverine Hazard Lands •Lakeshore Hazard Lands •For Riverine will use a one-zone and two-zone concept •Regulatory Flood Standard - 1/100 yr flood for Riverine flood plains (except GRCA) •Regional for GRCA watershed •Permitted uses in flood plains (lists 8 types) •Lake Erie shore is subject to fluctuating water levels, wave action and storms and seichie episodes	•Right-Of-Way widths: -Arterial - 36m -Collector - 30m -Local - 20m	•Prior to the approval of any development application, the County may require the preparation of any or all of these studies: -SWM plans -Provide general criteria to be considered when reviewing applications for development within designated Hamlets (availability and provision for adequate SWM facilities -Special Hamlet Policies -Detailed studies - SWM including erosion and water quality and quantity control shall be required -Erosion and sediment control required to the satisfaction of the County, conservation authority or others -Construction methods and techniques which prevent and control pollution will be required (applies to public works also)	•New development and redevelopment in Urban Areas shall generally proceed where the development is fully serviced by adequate drainage and SWM facilities •All new development in non-urban areas shall be subject to SWM practices •SWM studies will be required for development proposals •In all instances the need for SWM facilities will be determined by the county, conservation authority or any other agency having jurisdiction •SWM will provide provisions and methods to ensure that quantity and quality of runoff will not exceed pre-development levels or appropriate levels as determined by the County, conservation authority and other agencies	•Prohibited	•Open and closed Municipal Drains will be designed, constructed and maintained to reduce negative effects on the environment
Haldimand County	•June 1, 2006	•Will amend OP with the results of the Source Water Protection Strategy	•County may participate in international, national, provincial and local initiatives aimed at protecting the source supply, and improving overall quality of water	•n/a	•One-zone - entire flood plain defines the floodway •Two-zone - development that will require flood proofing •Flood and erosion control structures are permitted (it does not explicitly say SWM facilities) •Lists permitted and prohibited uses within Lakeshore Hazard lands	•Alternative standards may be accepted for compact urban form	•n/a	•May use existing watercourses for SWM purposes	•n/a	•n/a
Town of Lincoln	•May 2006	•n/a	•n/a	•Planned developing neighbourhoods through preparation of Secondary Plans •OP provides list of what the Secondary Plans should include •Neighbourhood Plans - includes developing urban design guidelines •OP provides goals of the secondary plan such as: -flexibility to adapt to new development trends -prior to the approval of any new development - The town shall carry out comprehensive Neighbourhood Secondary Plans	•Special Policy Areas - allows existing development within a floodplain to expand •Discourages development in these areas, EIA are required to demonstrate the development will not impact the environment	•n/a	•All new development and redevelopment within the town shall be served by a storm drainage system that is satisfactory to the Town, NPCA and MNR •SWM shall be in accordance with existing MDP's •Develop comprehensive SWM plans for development in urban areas •Isolated development SWM plans shall incorporate on-site control techniques for quality and quantity control •Sediment and Erosion control during development •Quality control through ponds and/or lot level controls •Underground storage may be permitted •Council promotes naturalized methods •Designed at a minimum to MOE standards	•Development of Urban Areas	n/a	

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Town of Fort Erie	•Draft	•Necessary restrictions shall be placed on development **abd?** site alteration to protect all municipal drinking water supplies and designated vulnerable areas	•Town shall participate with Region and NPCA to complete watershed studies and provides some key components of a subwatershed plan •Where a major land use change or plan is proposed that goes beyond an individual site specific development proposal such as a "Community or Neighbourhood Level" an "Environmental Planning Study" will be required	•These plans will be prepared for areas of the Town to provide a basis for more detailed planning •Indicate how the goals and policies of the official plan are to be implemented prior to development proceeding •Provides policies for the neighbourhood plan (i.e. compact development, redevelopment, etc.)	•Flooding Hazards, erosion hazards or dynamic beach hazards •Use 100 year flood to define flooding hazard	•n/a	•A SWM plan and sediment and erosion plan shall be required with a development application depending on the scale of the development proposal and environmental conditions •SWM plans shall be prepared in accordance with MOE standards and where a EIS is being prepared for the development, the SWM plan shall be coordinated with and integrate any recommendations of the EIS	•n/a	•n/a	•n/a
Town of Fort Erie	•Draft	•Development or site alterations shall be restricted around sensitive surface water features and sensitive groundwater features •Source water protection plans such that those features and their related hydrologic function are protected, improved or restored through appropriate mitigative measures and/or alternative development approaches	•OP recommends an Environmental Advisory Committee to review watershed plans, or other environmental studies	•n/a	•n/a	•n/a	•Need to protect rivers and creeks from destructive effects of Storm water runoff SWM studies to be carried out in consultation with NPCA & Region assess D/S constraints •accommodate major & minor system •Sediment & erosion control during construction •Storm drainage to be constructed completely separate of sanitary sewers	•n/a	•n/a	•n/a

Official Plan Name	Date	Source Water Protection	Watershed Planning	Secondary Planning / Neighbourhood Control Plans	Hazard Land Policies	Transportation	Development Application/SWM Requirements Sediment & Erosion Control	Servicing	Combined Storm and Sanitary	Municipal Drains
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City of Port Colbourne	•Draft Sept. 2006	•NWQPS •Groundwater protection areas •Low to high risk contaminants •Hydrogeologic studies required for areas at risk for proposed development •Nutrient Management Plans	•n/a	•n/a	•100 year storm elevation flood proofing of development	•Reduced road ROW may be permitted for one way traffic for example (LID opportunity)	•Plans must include a SWM plan, including lot grading, drainage, erosion and sediment control plans, in accordance with MOE	•Stormwater will be managed on site and will have no adverse impacts on adjacent properties •Prohibit combined sewers and recommends separating existing systems	•n/a	•n/a
City of Hamilton	•unknown	•Hydrogeological Studies •Council shall approve study guidelines to be used by proponents and professionals when preparing development feasibility and hydrogeologic studies •Describes what the results of the study are used for •Suitability of the site for development	•City shall work co-operatively with the CA, stakeholders and other agencies to prepare and implement watershed plans •SUBWATERSHED PLANNING -subwatershed study TOR to be developed in consultation with the CA What should be included in the subwatershed plan •Once endorsed by Council, the city must implement the recommendations wherever possible through: -amendments to the OP -secondary Plans -zoning bylaw amendments -conditions of approval for new developments -environmental assessments of servicing and infrastructure plans -habitat restoration and landowner stewardship	•All applications for development shall conform to the recommendations in a Secondary Plan as it pertains to the subwatershed plan •Supposed to follow the policy direction of the OP but provide more detail on landuse densities, design requirements etc •They are adopted as amendments to the plan •City prepare the TOR -provides what the secondary plan should include	•n/a	•n/a	•SWM Plans •Maintenance of groundwater quality and flow and storm base flow •Protecting water quality and aquatic species and their habitats •Prevention of channel erosion and flood risk •minimize disturbance to existing drainage patterns	•SWM ponds are prohibited within key heritage features and key hydrologic features or their vegetation protection zones •Where appropriate an integrated approach is used to minimize storm flows and structures by such measures as discharge controls and conveyance techniques on individual lots (LID potential) •SWM plans shall comply with standards and targets of approved watershed plans and other relevant municipal studies relating to the provision for SWM	•n/a	•n/a

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Region of Niagara	•January 2004	•Development and site alteration restricted in the vicinity of vulnerable groundwater features Additional studies may be required to demonstrate development will not impact groundwater	•Recommends the ecosystem approach fro environmental planning such as watershed studies to guide development and conservation at a broad level •Provide general requirements of watershed studies	•Encourages preparation of secondary plans (neighbourhood plans, urban renewal plans) •Environmental Planning Studies are required for Secondary Plans •Not required for individual site specific development proposal	•Provide policies for Hazard Lands	•n/a	•SWM Report including Sediment and Erosion control plans to be submitted with an application for development in accordance with Region Policies, MOE and existing environmental planning studies	•n/a	•Elimination of combined sewer overflows and bypasses shall be Regional priority	•Region supports Municipal Drainage projects that include Best Management Practices
Town of West Lincoln	•June 1998	•Development should be directed away and restricted in hydrogeologically sensitive areas	•Promote watershed management plans	•n/a	•Provide policies for Hazard Lands	•n/a	•n/a	•n/a	•n/a	•Determine what design requirements are necessary to eliminate, mitigate or compensate for adverse effects on fish habitat
Town of Pelham	New Draft 2006 - Not yet released	•n/a	•n/a	•Prepares Secondary Plans	•n/a	•n/a	•In accordance with Secondary Plans	•n/a	•n/a	•n/a
City of St. Catharines	•March 2006	•n/a	•n/a	•These guidelines should be read in conjunction with the general policies set out herein and other relevant sections of the Official Plans as they apply to the designated secondary planning area.	•Development within flood plains to be cognizant of flood susceptibility	•n/a	•n/a	•Minimize adverse impacts on the local groundwater systems and baseflow minimize pollution to watercourses •Minimize release of sediment to storm sewers and water bodies from construction practices •Where any area is partially developed but is deficient in storm drainage the design and installation of the necessary works for new development shall accommodate existing development where appropriate	•All new development in the urban area shall be connected to the sewage disposal system. All sanitary sewers constructed henceforth shall be completely separated from any storm drainage facilities and the City will progressively separate present sewers from all stormwater connections.	•n/a
City of Niagara Falls	•December 2005	•n/a	•Council shall develop and adopt SWM plans for watershed areas in advance of major development or redevelopment	•n/a	•n/a	•n/a	•All new development or redevelopment within the City be connected to and serviced by a suitable storm drainage system	•n/a	•n/a	•n/a
Town of Niagara on the Lake	•October 2003	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a

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Town of Pelham	•Updated (not released yet)	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a

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Township of Wainfleet	•n/a	•Development should be directed away and restricted in hydrogeologically sensitive areas •Proponent of new development may be required to submit hydrogeological and hydrological studies to demonstrate no impacts to groundwater	•Land use planning policies and decisions shall be co-ordinated with and support related water initiatives such as Watershed management plans	•n/a	•n/a	•n/a	•Proposed development shall not adversely affect water quality and quantity - base flow, DO, TSS, Temperature, bacteria etc Encourage infilling, re-use and redevelopment;	•Best management practices and stormwater management techniques will be implemented in accordance with applicable Provincial policies and guidelines. For large-scale development, subwatershed plans should be prepared. Such plans should demonstrate how water and related resources will be managed to meet surface and groundwater •46 quality and quantity targets.	•n/a	•The water quality policies of this section shall not be construed to restrict or in any way inhibit any Township drainage works pursuant to the Drainage Act, RSO 1990.
LIST OF ACRONYMS: **OP - OFFICIAL PLAN** **GRCA - GRAND RIVER CONSERVATION AUTHORITY** **SWM - STORMWATER MANAGEMENT** **EIA - ENVIRONMENTAL IMPACT ASSESSMENT** **MOE - ONTARIO MINISTRY OF THE ENVIRONMENT** **MNR - ONTARIO MINISTRY OF NATURAL RESOURCES** **NPCA - NIAGARA PENINSULA CONSERVATION AUTHORITY** **MDP - Master Drainage Plan** **TOR - Terms of Reference** **BMP - BEST MANAGEMENT PRACTICE** **D/S - DOWNSTREAM** **NWQPS - NIAGARA WATER QUALITY PROTECTION STRATEGY** **DO - DISSOLVED OXYGEN** **TSS - TOTAL SUSPENDED SOLIDS**										

Appendix D:

Official Plan Name	Design Principles & Urban Design Guidelines	Plans of Subdivision and Condominium, Lot creation, etc.	Parking	Site Plan Control	Environmental Impact Statement	Greening & Ecological Policies	Monitoring
Official Plan	•Recommends establishing Urban Design Guidelines •Recommends that urban design guidelines include SWM •County will work to establish Urban Design Guidelines •Once guidelines are established proponents will be required to develop in accordance with these guidelines	•The subdivision and Condominium Plan approval process and other agreements will be used by Council to ensure that policies and land uses of the OP and applicable Secondary Plans are complied with and that a high standard of design is maintained in new development areas •Council will only approve plans of subdivision or condominium conforms with the policies and that adequate servicing such as storm water drainage can be provided	•County provides interim policies that may be amended subject to detailed parking studies •Reduced parking standards •Parking - Supports shared parking policies (pg 50), recommends parking studies to develop overall parking strategies	•Does not include: -farm buildings -single detached dwellings, semi-detached dwellings and duplexes -Grading, drainage and SWM to be addressed through site plan control process	•n/a	•Protect Base Flow •Maintain or enhance •Maintain, protect and enhance riparian cover in headwaters and along streams •Existing sources of water pollution will be reduced and eliminated where possible	•n/a
Haldimand County	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a
Town of Lincoln	•Innovative Housing will be considered by OP amendments •Energy conservation that includes retention of existing trees and vegetation •The clustering of units •Apply SMART GROWTH principles •Development & Redevelopment - proposals will expect to include significant landscaping component - Minimize vegetation removal and replace with native species - Peripheral plantings and landscaped islands in parking lots will be encouraged for private parking lots - GREAT FOR LID POTENTIAL - Want tree planting within municipal parking lots, peripheral planting and islands (Great for LID potential) • Design Guidelines for Tree Planting planted to form canopy over roads when mature SWM Should be designed as integral features of the landscape native and flood tolerant species SWM channels located in parks could be meandered and natural •Integrate with trails •Institutional and commercial •Parking should be broken down into pods with planting strips (LID potential)	•Development or redevelopment shall be by plan of subdivision •Where 5 or more new residential lots are being created or where a new road or road extension is required, council will require development by registered plans of subdivision	•Recommend islands, peripheral planting etc	•Commercial Development & redevelopment will be subject to site plan control - no mention of SWM •Exemptions: -Any alteration or addition to an existing one unit or two unit dwelling -Any new one or two unit dwelling -Industrial & Prestige Industrial Developments will be subject to site plan control - no mention of SWM	•n/a	•n/a	•n/a

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Town of Fort Erie	•Neighbourhood Planning Policies: -alternative lotting patterns -preserve and enhance natural features found on site	•Used to ensure that policies and land uses of the Official Plan and Secondary Plan are complied with •Ensure adequate servicing for storm water drainage	•Encourage the efficient shared use of parking, loading and storage areas	•All of the Town of Fort Erie will fall under site plan control •Single detached or semi-detached or additions are not subject to site plan control •Town to establish uniform site plan control policies •Applied to development and redevelopment of land	•Development and site alteration adjacent to significant areas •Explains when required, TOR in consultation with NPCA and what it should include	•Specific to Vineland Area - Sediment and erosion control - Encourage infiltration to maintain base flow through grading - Minimize parking surfaces to greatest degree possible	•n/a
Town of Fort Erie	•Designed to be visual features •Shallow naturalized ponds should not be fenced •Designed to appear contiguous with natural areas •**Incorporate trails?**	•n/a	•n/a	•n/a	•n/a	•Open Space policies recommend protecting and incorporating existing natural areas into open space system •Protect through: -land acquisition -requesting others to purchase (NPCA) -enter into agreements -encouraging landowners to protect -consider higher densities -tree cutting by-laws -lot grading & drainage by-laws -site alteration by-laws -removal of topsoil bylaw -conservation easements -property tax incentives -naturalization of SWM facilities -municipality encourages individuals and private industry to follow these policies	•n/a

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City of Port Colbourne	•Have regard for the Regional Municipality of Niagara's Model Urban Design Guidelines •These guidelines were developed to provide design principles and specific guidelines for a range of development types and conditions relevant to the Niagara Region. •The guidelines are being made available by the Region as a reference material for local adaptation and adoption. It is hoped that over time, local municipalities will share success stories with the Region and one another to perpetually improve this set of Model Guidelines. The application of each guideline or guideline component alone does not constitute Smart Growth. It is the application of the principles and related guidelines collectively which, over time, will result in the implementation of Smart Growth. •Port Colbourne will conduct separate studies to create more specific guidelines resulting from these studies	•n/a	•Landscape islands to break-up parking with salt tolerant vegetation	•Entire municipality is a site control plan area •Requires same studies as required for plan of subdivision	•Environmental Impact Study is required for development or site alteration in or adjacent to Environmental Areas •Provides an appendix of general requirements for an EIS	•n/a	•n/a
City of Hamilton	•n/a	•The division of land shall occur by registered Plan of Subdivision where a new road or an extension to an existing road is required •More than 4 lots are to be developed •Plans must conform to the policies of the OP •May not impact the environment •Rural lot creation says nothing about SWM requirements	•n/a	•All lands are within the Site Plan control area •Council may establish a bylaw that explains what classes of development will be exempt	•Provides triggers for an EIS •Environmentally Significant Area Impact Evaluation Group (ESAIEG) - shall review all EIS reports and provide technical advice to city staff •Require Environmental Impact Statements •"Council Adopted" EIS guidelines which shall be used by proponents and professionals when using an EIS •Development proposed within the Greenbelt Plan Area through a consent, Plan of Subdivision, Zoning By-law, Site Plan approval, OP amendment, site alteration bylaw shall require an EIS	•Tree and woodland protection and reforestation •Best to protect existing where feasible •Woodland Conservation Bylaw •Street Tree Management Policy	•City to support field studies and develop a monitoring plan in co-operation with the CA to support landuse planning and resource management decision making

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Region of Niagara	•n/a	•Rural residential development site should not have detrimental effects on water quality and quantity	•n/a	•Region supports the use of site plan agreements	•Provide Environmental Impact Study Guidelines	•City shall support agencies, community organizations, and private landowners in their efforts to protect and enhance NHF through private habitat restoration, and stewardship, land trusts, public acquisition, conservation easements, property tax mechanisms	•n/a
Town of West Lincoln	•n/a	•n/a	•n/a	•All of the township is considered under site plan control	•n/a	•n/a	•n/a
Town of Pelham	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a
City of St. Catharines	•The objectives of these standards are to: improve the livability of the community; improve cost efficiency; support environmental sustainability; and allow for more adaptability and flexibility. For example, creating a more compact pattern of development and allowing for a range of housing types in neighbourhoods are two ways of achieving these objectives. Alternative development standards have been incorporated into the Official Plan to address changing values and emerging concepts; and the City will, where appropriate, incorporate alternative development standards as a means of achieving housing affordability and to meet the demand for smaller and more diverse forms of housing	•n/a	•n/a	•n/a	•Proponents of any development adjacent to environmentally significant areas may be required to submit an Environmental Impact Study (EIS) or other supporting information that satisfies the City of St. Catharines and the Region of Niagara that there will be no negative impact on the natural features or ecological functions on the adjacent environmental significant area. Environmentally significant areas include the Lake Ontario shoreline, Provincially Significant Wetlands, significant natural corridors such as the Fifteen Mile Creek corridor, and the Twelve Mile Creek corridor, fish habitats, significant woodlots (woodlots over 2 hectares), and areas identified by the province or its agents as Areas of Natural Scientific Interest (ANSI).	•City Council adopted a Green Plan to examine the benefits of green space on water quality among other benefits •Designate lands for environmental protection that protect water quality and quantity, water storage or recharge areas	•n/a
City of Niagara Falls	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a
Town of Niagara on the Lake	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a	•n/a

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Town of Pelham	•n/a	•n/a	•n/a	•n/a	•n/a	•Supports NPCA with support education, outreach and landowner stewardship programs	•n/a

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Township of Wainfleet	•n/a	•n/a	•Encourage the development of central and common parking areas	•n/a	•Environmental Impact Studies (A) An Environmental Impact Statement (EIS) means a study prepared by a qualified environmental professional to the satisfaction of the Township: (1) To identify and assess the impacts of a proposed development or site alterations on the significant environmental features and ecological functions of a natural area; (2) To identify and assess alternative measures to prevent or minimize adverse impacts and recommend which measures are appropriate, and (3) To make recommendations on the advisability of proceeding with the proposal. (B) Council will provide Regional Niagara and other appropriate agencies with the opportunity to review and comment on an EIS and its recommendations.	•To protect the natural resources and environment of the Township. Method of Implementation: By the adoption of policies to prevent the pollution of air, soil and water. By the adoption of policies for the identification and controlled use of granular reserves. By the maintenance of a productive forest within the Township for its social, economic, recreational and environmental values. By the adoption of policies that preserve and enhance the natural, historic and scenic qualities. By the adoption of policies to protect significant natural heritage features and functions in the Township and to support their restoration where they have been degraded.	•n/a
LIST OF ACRONYMS: **OP - OFFICIAL PLAN** **GRCA - GRAND RIVER CONSER** **SWM - STORMWATER MANAGE** **EIA - ENVIRONMENTAL IMPACT** **MOE - ONTARIO MINISTRY OF T** **MNR - ONTARIO MINISTRY OF N** **NPCA - NIAGARA PENINSULA C** **MDP - Master Drainage Plan** **TOR - Terms of Reference** **BMP - BEST MANAGEMENT PR** **D/S - DOWNSTREAM** **NWQPS - NIAGARA WATER QU** **DO - DISSOLVED OXYGEN** **TSS - TOTAL SUSPENDED SOL**							

APPENDIX E
Committee Meeting Minutes

engineers
architects
planners

Project:	NPCA SWM Policy
TSH No.	54-22280
Meeting Date:	Thursday, March 2, 2006
Meeting Time:	12:30 to 3:30pm
Report Date:	Wednesday, March 15, 2006
Recorder:	Phil James
Page 1 of 3	

MEETING REPORT NO. 1

Note: If any of the contents of this meeting report differ in any respect from your own recollection of the points discussed or decisions reached, please notify us immediately. In the meantime, we will proceed in accordance with the understanding described herein.

LOCATION:

PRESENT:	Doug Evans	Niagara Falls
	Jack Bernardi	City of Thorold
	Bernie Duque	Town of Grimsby
	Bob Nesbitt	Town of Grimsby
	Ron Sheckenberger	Philip Engineering
	Robert Judd	Town of Fort Erie
	Dave Graham	Town Lincoln
	Mike Purcer	Region
	Scott Richardson	City of Welland
	Bob Michel	St. Catharines
	Doug Cherrington	RMN
	Dave Farley	RMN
	Tony D'Amario	NPCA
	Steve Millar	NPCA
	Ray Tufgar	TSH
	Phil James	TSH

PURPOSE: ***Stormwater Management, Erosion and Sediment Policies and Criteria Project Coordination Committee Meeting***

Action By

1. Master Planning

- Should speak to looking at enforcing what is in the current policies (if a subwatershed plan exists, make sure that SWM is meeting the targets)
- There should be a mechanism to ensure commitment's are made
- Provide direction or update procedures for subwatershed planning
- Look at formal updates rather than a complete new study due to cost constraints (i.e. amend subwatershed study)
- How will the policy affect the Official Plan and they way it is worded?
- MNR has been used in the past, provide an overall approach and guidance
- There is a wide spectrum of practices across municipalities (advanced to minimal)
- The document must be flexible and guidance in tune with local issues
- Smaller scale development and investment is difficult for larger watershed studies
- How to implement centralized ponds

Action By

- Subwatersheds cross boundaries, unless mandated how will they get done
- General consensus was that guidance is needed

2. Quality/Quantity

- For the Region of Niagara the minimum target is level II unless otherwise set
- A common question asked to municipalities is what level of protection is required when outletting to a storm sewer?
- To determine treatment requirements need to look at what happens to the drainage in the storm sewer between the inlet and outlet, what is the ultimate outlet? Does it matter if the water travels 10m vs. 100m if it reaches the same outlet?
- Consider off-site treatment where it can be performed more effectively
- What are some typical redevelopment and infilling BMP's?
- When are on-line ponds appropriate?
- Look beyond current water quality objectives
- Targets need to be set by Conservation Authority or Region
- Sensitive groundwater recharge/discharge areas (will the SWM facility affect groundwater)

3. Municipal Design Criteria

- Need to recognize the Municipal Design Manuals
- Need to set minimum standards
- Which data is to be used for Urban vs Rural modeling
- Does existing data need to be updated? (i.e. statistical data, climate data)
- Recommend appropriate design approaches for major and minor systems but not too rigid
- Use disclaimers that indicate other methods may be used but demonstrate that the method is appropriate

4. Redevelopment/Infill

- City wide strategy or individual site level controls?
- Consider maintenance for private vs public lands
- Need guidelines for stormwater discharge to closed systems
- Need for site alteration by-law to stop grading before approvals
- Require a permit prior to earth cutting with S&E plan
- Problems
  - What happens when S&E control fails or are not installed properly?
  - Trouble enforcing on-site S&E control
  - Maintenance issues
  - Where are the teeth?
- Provide the definition of a deleterious substance according to the Fisheries Act

Action By

- MOE has indicated that they will start enforcing the agreements in the COA (i.e. COA stipulates maintenance requirements)
- Currently site plan stipulates maintenance report every year
- Need for more by-law enforcement officers
- Maintenance easements that provide access to private lands when maintenance is not being performed
- Letter of credit to reclaim costs
- Intensification opportunities and challenges with SWM implementation
- Municipalities would like flexibility on the type of facilities they end up assuming
- Municipalities would like to know the various alternatives available if they are not comfortable with what the developers proposes (i.e. alternative BMPs)
- What are the SWM requirements for Brownfields being converted to residential developments?
- Greenbelt legislation promoting intensification in cores

4. Technical Review

- Need a list of review items to ensure all aspects are being covered
- Decision tree to decide when SWM is required and who has jurisdiction over the outlet facility
- MOE and NPCA send out conflicting approvals and comments
- Need consistency as to when NPCA gets information
- Proposed that NPCA make comments prior to MOE submission
- Need a check list before COA is signed
- Document should include maps that identify fisheries and hydrological sensitive lands
- NPCA should be involved in all reviews to protect the receiving stream

5. Monitoring & Maintenance

- Need monitoring criteria in SWM policy/subdivision agreements
- DC funding is needed for watershed monitoring
- Pre-development, during development, post development monitoring
- Effectiveness monitoring
- Criteria that need to be satisfied before a SWM facility will be assumed by a municipality
- Monitoring of SWM facilities post assumption

engineers
architects
planners

Project: NPCA SWM Policy

TSH No. 54-22280
Meeting Date: Friday, April 7, 2006
Meeting Time: 10:30am to 3:00pm
Report Date: April 21, 2006
Recorder: Phil James, Ray Tufgar

MEETING REPORT NO. 2

Note: If any of the contents of this meeting report differ in any respect from your own recollection of the points discussed or decisions reached, please notify us immediately. In the meantime, we will proceed in accordance with the understanding described herein.

LOCATION:

PRESENT:	Doug Evans	Niagara Falls
	Doug Cherrington	RMN
	Dave Graham	Town Lincoln
	Brian Bishop	Philips Engineering (Town of Grimsby)
	Scott Richardson	Town of Welland
	Simon Leung	St. Catharines
	Ray Tufgar	TSH
	Phil James	TSH
	Rick Volpini	City of Niagara Falls
	Robert Judd	Town of Fort Erie
	Dave Farley	RMN
	Steve Miller	NPCA

PURPOSE: ***Stormwater Management, Erosion and Sediment Policies and Criteria Project Coordination Committee Meeting***

Action By

Brief Review of Last Meeting, Minutes & Discussion

-as part of the MOE COA the Municipality partly approves design with signature
- municipality is responsible for Public safety and environmental protection
- there are instances where charges have been made for poor environmental protection
- municipalities need to practice due diligence
-Provincial Policy indicates what the Province expects
-the new SWM policies will act as a tool for municipalities to do their own check
-not relying on others, due diligence
- SWM outlets are being looked at in the same way as WWTP effluent

- concern was raised over why the municipality should sign off that the facility has been constructed properly when the MOE has requested the facility
-municipalities have developer do monitoring at city's request or hire an independent inspector to monitor construction
-retain consultant to do final inspection prior to assumption to ensure the facility has been constructed according to design drawings & specifications and also to review monitoring data to ensure the facility is operating according to the design.

Action By

- the draft decision tree/flow diagram will need revisions then will be re-circulated for comment
- how do you determine when COA is required?
- large parking areas that are acting as storage facilities with orifice plates (would a COA be required?)
- recommend that on each application the MOE is contacted to verify if COA is required.
- for private facilities municipalities have to sign off for approval.

Action — TSH
- draft decision tree/flow chart for approval to be revised than circulated to NPCA and committee for review

5.0 Flood & Erosion protection

-typical target of 40 m3/ha
-use MOEE guidelines in absence of subwatershed study
-or insist on a geomorphic study? (general consensus was no)
- Sediment & Erosion control (S&E control) is required for all construction sites
-sediment control plan is required for all applications (Greenfield, infill, redevelopment)
-NPCA looks for consistency but does not specify what is needed
- Development adjacent to a watercourse has always required S&E control for environmental reasons
- stress the importance of proper S&E control from a maintenance perspective
- it was pointed out that not all departments have the opportunity to review building permits and therefore review & comment proposed S&E control plans
-developments that are exempt from site control plan process and do not require SWM includes schools and hospitals, S&E control is still required

Actions — TSH
- policy to identify S&E control issues and the need for enforcement
- policy should refer to sediment and erosion control standards (i.e. MTO manual, existing draft policies)
- recommend that land developer prepare and submit S&E control inspection reports on a routine basis (i.e. bi-weekly)
- provide sample S&E control reports in policy appendix

Site alternative by-laws

Action By

- not all municipalities have site alternative bylaws
- all municipalities should have this by-law and the bylaw should address S&E control
-depending on how existing bylaws are written they may not apply to S&E control and SWM
-the bylaws tend to focus more towards restricting private citizens from filling in ditches or modify lot drainage
- Site alteration bylaws should be created or updated to address S&E control (i.e. silt fencing, sediment traps, etc.)
- S&E control should also be entrenched in subdivision agreements

Actions — TSH

- Policy should address the need for comprehensive site alteration bylaws and that they should be updated to address S&E control

Floodplains

-NPCA is actively updating the floodplain mapping within the next 5 years
- floodplains – issue – allowing quality (only)
- control ponds in floodplains – where quality is not required
- now outside system is unofficial policy
- floodplain policy is captured elsewhere (CA Act regulation)
- pre-past requirements in absence of substantial studies
- stay out of 5 year perhaps in the 100 yr. as long as your preserve the stage storage relationships of the floodplain
- address flood moderation roles of existing natural features
-NPCA indicated that these types of feature (i.e. wetlands, woodlots, etc.) are being identified in separate studies

Actions — TSH

- policy to recognize the need for preservation and important roles these features play in SWM
- SWM policies to provide direction on where SWM facilities may be located in floodplains (i.e. outside the 5yr, within the 100yr however must maintain stage storage relationship)

6. Infiltration and Groundwater Protection

- reference/include maps that indicate where study is needed to address the SWM approach required (i.e. hydrogeologic assessments)
- direction regarding suitable topsoil depths for impervious areas may be provided in the policy
-who has responsibility for groundwater?
- if infiltration targets can't be achieved recommend alternative BMP's

Actions — TSH

- reference groundwater and fisheries maps and include in report
- need for further studies when building in groundwater sensitive areas (documentation that proposed SWM facility will not contaminate groundwater, impact fish habitat, etc.)

7. Natural Channel Design, Erosion Control & SWM Aesthetics

Action By

-should provide direction on SWM pond landscaping
-variety of approaches (fencing vs. naturalization)
-appropriate pond side slopes
-NPCA can provide appropriate plant species that should be used when landscaping SWM facilities (i.e. Carolinian Species)
-need to indicate that SWM facilities are typically intended for passive use – need to consider public safety in any use
- landscaping (Public safety, operation of pond, environmental enhancement)

- aesthetic guidelines will avoid the creation of SWM facilities that are large holes in the ground
-but also need to address use of areas (can have conflict at source, conveyance and the use of area)
- recognize expectations over fast drainage, standing water and West Nile Virus (WNv)
- Stream maintenance, enhancement, realignment, etc. is controlled by a number of agencies (DFO, MNR, NPCA)
- retrofit and discourage outletting pipe drains directly into creeks where possible (permits required by NPCA)

Action — TSH NPCA
-provide direction on SWM pond landscaping (i.e. sample aesthetic guidelines)
-NPCA to provide species list of suitable vegetation around SWM facilities (Due to Niagara climate there is the opportunity to plant Carolinian Species, increased diversity)
- indicate that ponds are typically for passive use and need to consider public safety
- WNv considerations
- Outlet considerations into natural channels

8. Best Management Practices (BMP's)

-Refer to BMP's in MOE guidelines
-If developer wishes, municipality would consider an application that includes other measures
-what economic incentives currently exist?
-buffers -only incentive in rural area
-nothing for urban
-typically parkland streams have been given buffers
- need to consider treatment train approach
- proposed BMP's will need to address:
-will it work when built
-does it meet local policies
-can it be maintained properly (short and long term)
-is it protected from landowner intervention
- in terms of maintenance, Niagara takes on easement over rear yard CB's

-policies should consider BMP's when doing SWM design

- should encourage incorporating SWM controls into the fabric of the development
-Source & conveyance control BMP's lead to smaller facilities (i.e. roof leaders and road side ditches can reduce SWM pond sizes)

Action By

-Policy must be flexible enough for municipal guidelines that do not allow certain BMP's
-consider if design will work, be continually maintained and be permanent
Action TSH
- policy to encourage and promote BMP in SWM planning

11. Maintenance and Retrofitting

- sediment disposal is an issue
-retrofit is a concern
-any retrofit needs to be addressed as part of Master Drainage Plans (MDP)
-MDP
  -to allow development
  -to update old plan
  -to deal with a drainage problem
- discuss typical inspection procedures & frequency of inspection
- develop SWM databases that are updated with inspection reports
- Maintenance records are good from a legal perspective (i.e. flooding damage and current inspection forms for maintenance)
-how often should the inspections be done?
Action TSH
- provide sample SWM pond inspection forms & programs

12. Stormwater Funding

-should we discuss
  -DC changes
  -Stormwater rates
-discuss where money comes from
-development changes act
-outline what other areas are doing – what are the trends
Action TSH
- provide overview of SWM funding sources and trends

13. Education

-Is needed
  -not a policy
  -but to help the policies work better
- programs such as the yellow fish road compliment SWM & pollution prevention
- Important to educate public about SWM infrastructure

Action TSH
- identify the importance of education and SWM management

14. Spill and Contingency

-already being dealt with
-Industrial/Commercial
  -spill prevention
  -OGS unit

		Action By
	- High risk hydrogeologic areas should have spill and contingency planning in place	
	Action	TSH
	- reinforce need for spill and contingency planning	
15.	**Linking Polices**	
	-Make a list of existing documents	
	-Need to list local documents in the policy -circulate to committee to see if there are others	
	Action	TSH
	- prepare a summary of policies, guidelines, bylaws related to SWM and circulate to committee members to review and update	
16	**Next Steps**	
	- draft policy	TSH
	- report outline - annotated	TSH
	- circulate minutes and coordinate next meeting date	TSH NPCA

engineers
architects
planners

Project:	NPCA SWM Policy
TSH No.	54-22280
Meeting Date:	May 30, 2006
Meeting Time:	10:00am to 12:00pm
Report Date:	June 2006
Recorder:	Phil James, Ray Tufgar

MEETING REPORT NO. 3

Note: If any of the contents of this meeting report differ in any respect from your own recollection of the points discussed or decisions reached, please notify us immediately. In the meantime, we will proceed in accordance with the understanding described herein.

LOCATION:

PRESENT:	Jamie Hodge	Town of Pelham
	Mike Wilson	Town of Pelham
	Bob Steele	Public Works – Region of Niagara
	Brian Bishop	Philips Engineering (Town of Grimsby)
	Bernie Dugue	Town of Grimsby
	Tony D'Amario	NPCA
	Steve Miller	NPCA
	Jack Bernardi	City of Thorold
	Rick Volpini	City of Niagara Falls
	Don Weatherbe	Donald G. Weatherbe Associates Inc.
	Ray Tufgar	TSH
	Phil James	TSH

PURPOSE: ***Stormwater Management, Erosion and Sediment Policies and Criteria Project Coordination Committee Meeting***

Action By

1. ***INTRODUCTION/BACKGROUND***

- Provide a an introduction to stormwater management and its importance (SWS 101), good education for and council (couple pages of explanation)
- Include in this section that The Niagara Water Quality Protection Strategy confirmed the need to create a standard SWM policy - "paraphrase recommendation"
-Using MOE as starting points then tailor for Niagara
-add preservation of individual municipal guidelines
- policies should supplement existing guidelines

2. ***OBJECTIVES***

- Emphasis that the primary objective is to protect water quality

Action By

3. ***POLICY/LEGISLATIVE FRAMEWORK***

-Add a section on the Drainage act – explain context, mention class authorization for drains
-Include a matrix that lists existing information for municipality to perform their own needs assessment (i.e. who has a site alteration bylaw who doesn't, etc.)

5. ***FRAMEWORK FOR MASTER DRAINAGE PLANNING***

-How to initiate these studies (purpose of study and how to fund)
- Studies are typically driven by development and led by the municipality – highlight funding as a challenge and point to funding section of policy
-Explain how the approach can make a difference in the size and cost of the facility

6. ***DEVLOPMENT TYPES, OPPORTUNITIES & CONSTRAINTS – DIFFERENCE OF APPROACHES***

- Introduce treatment train approach early in document
- Provide overview of the different development types and SWM opportunities

7. ***SWM REQUIREMENTS/CRITERIA***

-Pre-post water balance, pre/part on erosion - quantity

- Should we propose stringent criteria to encourage site specific studies?

-Should we collect money rather than tell a 15-20 lot subdivision to do a study?

Should we tell the developer they should manage all water quality and quantity on property and absorb that cost? or cash in lieu?

- Funding source options – What do we do in the interim?

- Where are you in the watershed and what makes sense?

-Use typical MOE guidelines for TSS, erosion, groundwater, quantity and modify according to site (i.e.12 Mile creek and introducing temperature targets)

-Should we word the policy such that municipalities prefer to do subwatershed planning?

- Include heading and description of Source Protection

-Some targets need to be addressed at the subwatershed level

Action By

- Don't just loot at pre=post look at hydrograph timing "water traffic management"
-Create an outlet decision tree and what needs to be considered (i.e. outlet to lake, creek, sewer, etc)
- Consider adopting an interim target given the option to take short answer or studied answer
-Could generate a cost for going over the target
-Provide a table that shows the various options available for SWM control and include performance or pollution removal efficiency

8. ***SWM BMP'S***

- Add a section about selection tools for road drainage

- Provide performance standards for the different BMP's

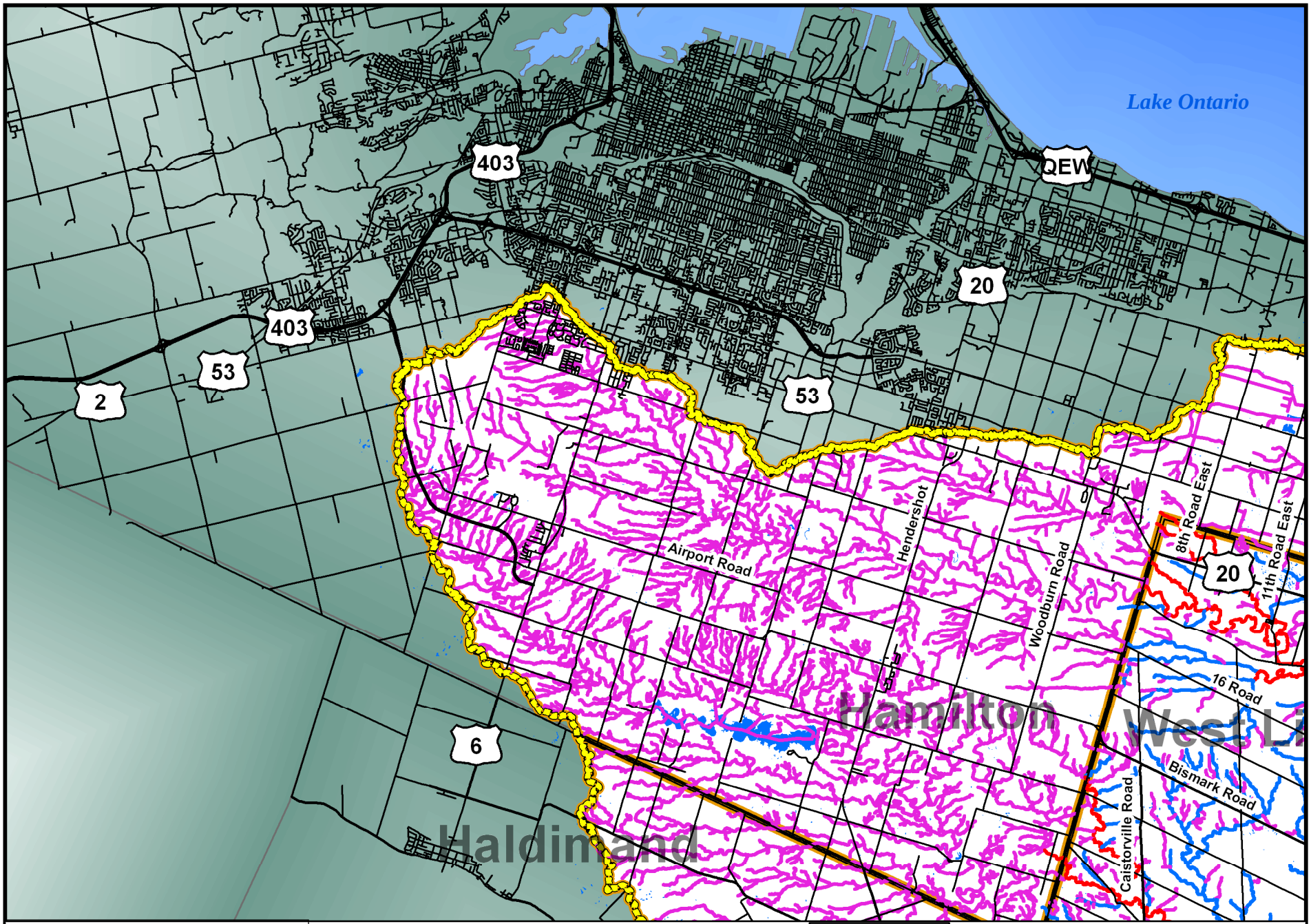
13. ***APPROVALS***

- Include a table that describes "who does what" (i.e. roles and responsibilities)

14. ***CONSTRUCTION STAGING REQUIREMENTS/CHECKLIST***

-topsoil preservation
-emphasize in the policy that grading should be phased to occur as needed and disturbed areas are to be seeded immediately

APPENDIX F
Fisheries Sensitivity Maps



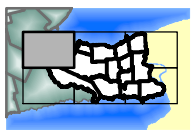
Legend

Fish Habitat Classification
- 'Crtical' Type 1
- 'Important' Type 2
- 'Marginal' Type 3
- 'Unclassified' No Data

- Road Network
- Waterbody
- NPCA Jurisdiction
- Municipal Boundary

Stormwater Management, Erosion and Sediment Policies and Criteria:

Fish Habitat Classification



0 1 2 4 6 8

Kilometers

North American Datum 1983, Universal Transverse Mercator 6 ° Projection, Zone 17N, Central Meridian 81° West

NIAGARA PENINSULA CONSERVATION AUTHORITY

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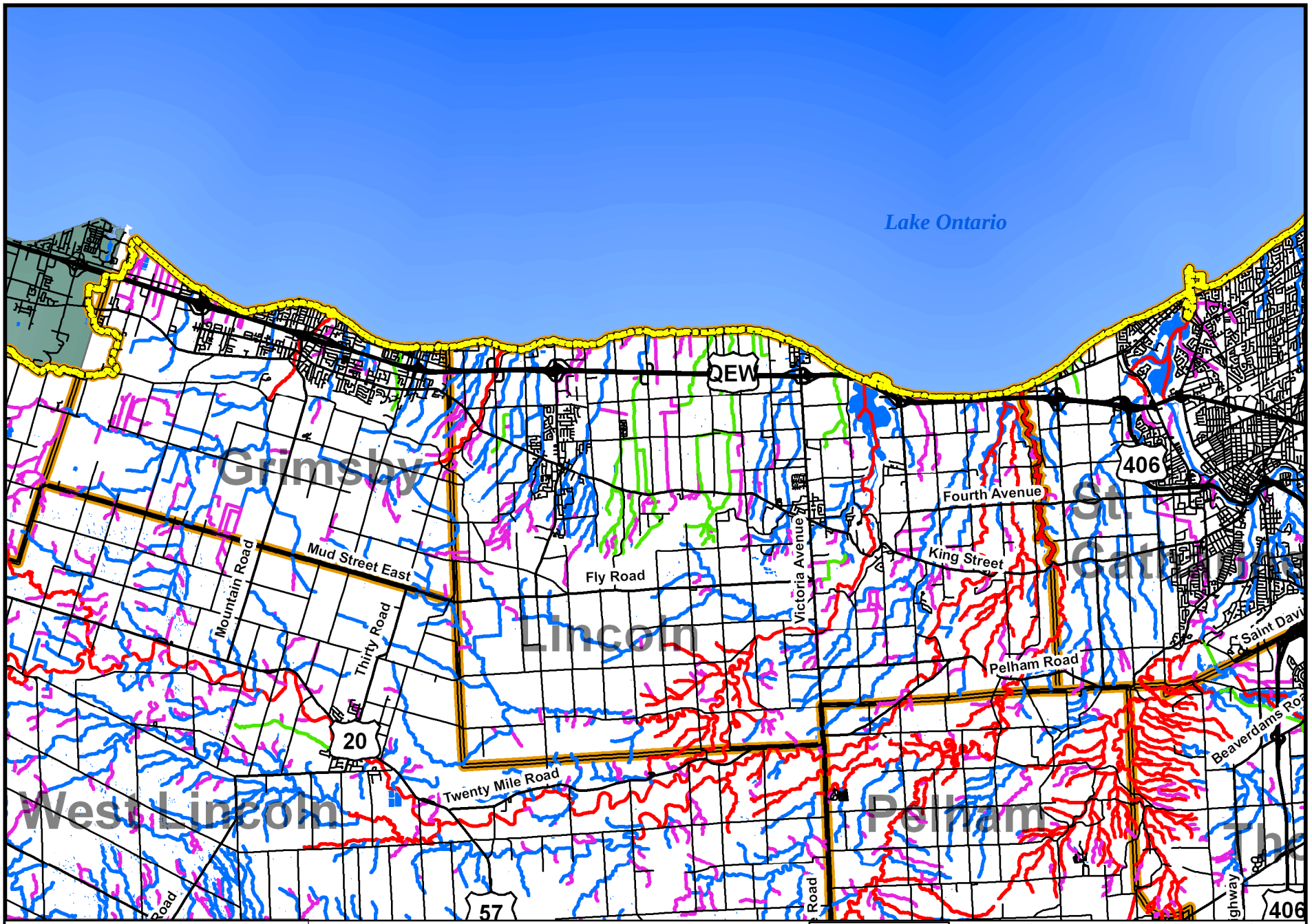

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Fish Habitat Classification
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- 'Important' Type 2
- 'Marginal' Type 3
- 'Unclassified' No Data

- Road Network
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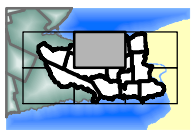
- NPCA Jurisdiction
- Municipal Boundary

Stormwater Management, Erosion and Sediment Policies and Criteria:

Fish Habitat Classification



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North American Datum 1983, Universal Transverse Mercator 6 ° Projection, Zone 17N, Central Meridian 81° West

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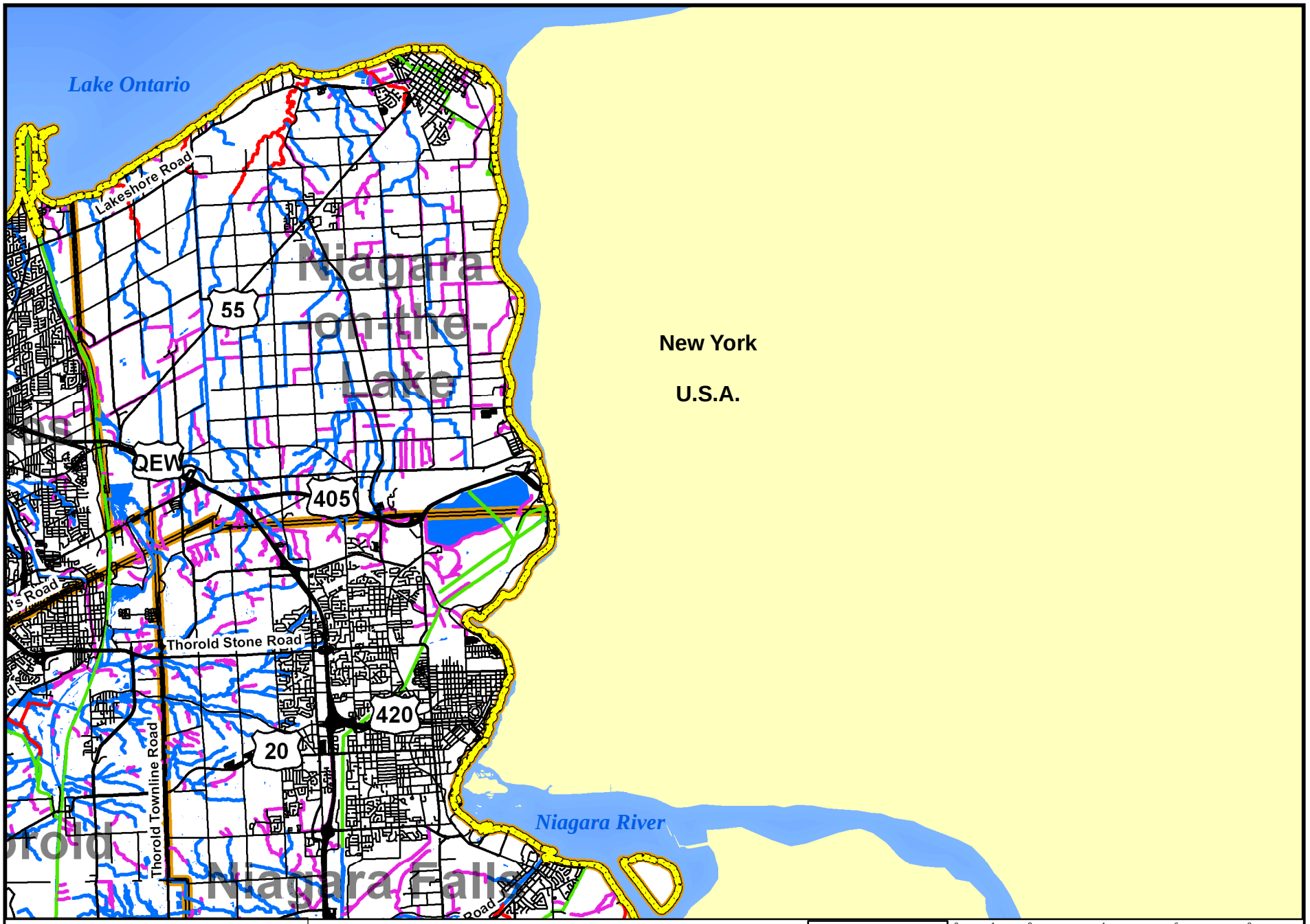

Legend

Fish Habitat Classification
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- 'Marginal' Type 3
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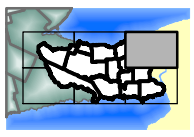
- NPCA Jurisdiction
- Municipal Boundary

Stormwater Management, Erosion and Sediment Policies and Criteria:

Fish Habitat Classification



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North American Datum 1983, Universal Transverse Mercator 6 ° Projection, Zone 17N, Central Meridian 81° West

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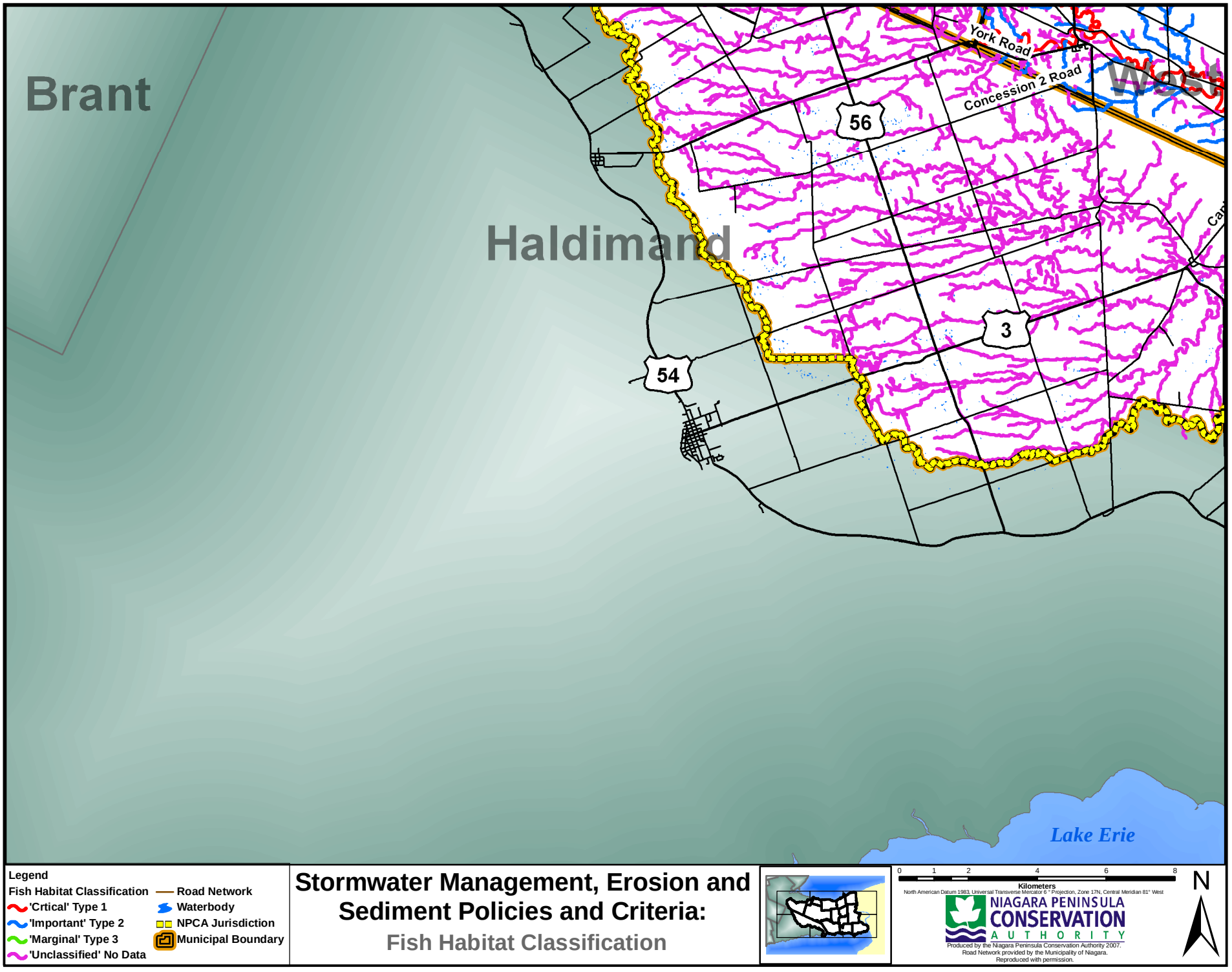
Brant
Haldimand
York Road
Concession 2 Road
56
54
3
Lake Erie
Legend
Fish Habitat Classification
'Crtical' Type 1
'Important' Type 2
'Marginal' Type 3
'Unclassified' No Data
Road Network
Waterbody
NPCA Jurisdiction
Municipal Boundary
Stormwater Management, Erosion and Sediment Policies and Criteria:
Fish Habitat Classification
0 1 2 4 6 8
Kilometers
North American Datum 1983, Universal Transverse Mercator 6 ° Projection, Zone 17N, Central Meridian 81° West
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Road Network provided by the Municipality of Niagara.
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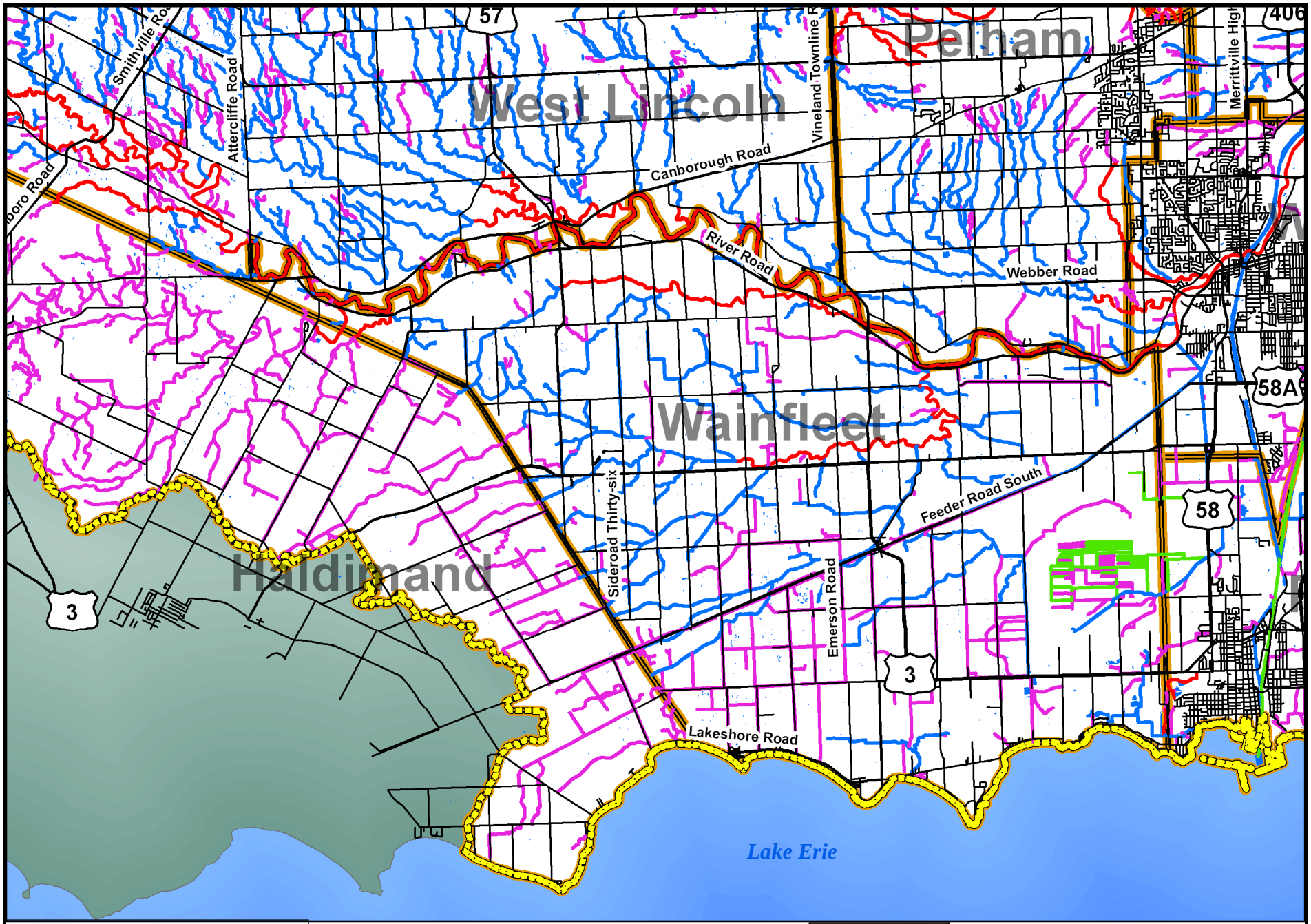

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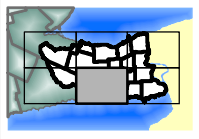

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Kilometers

North American Datum 1983, Universal Transverse Mercator 6 ° Projection, Zone 17N, Central Meridian 81° West

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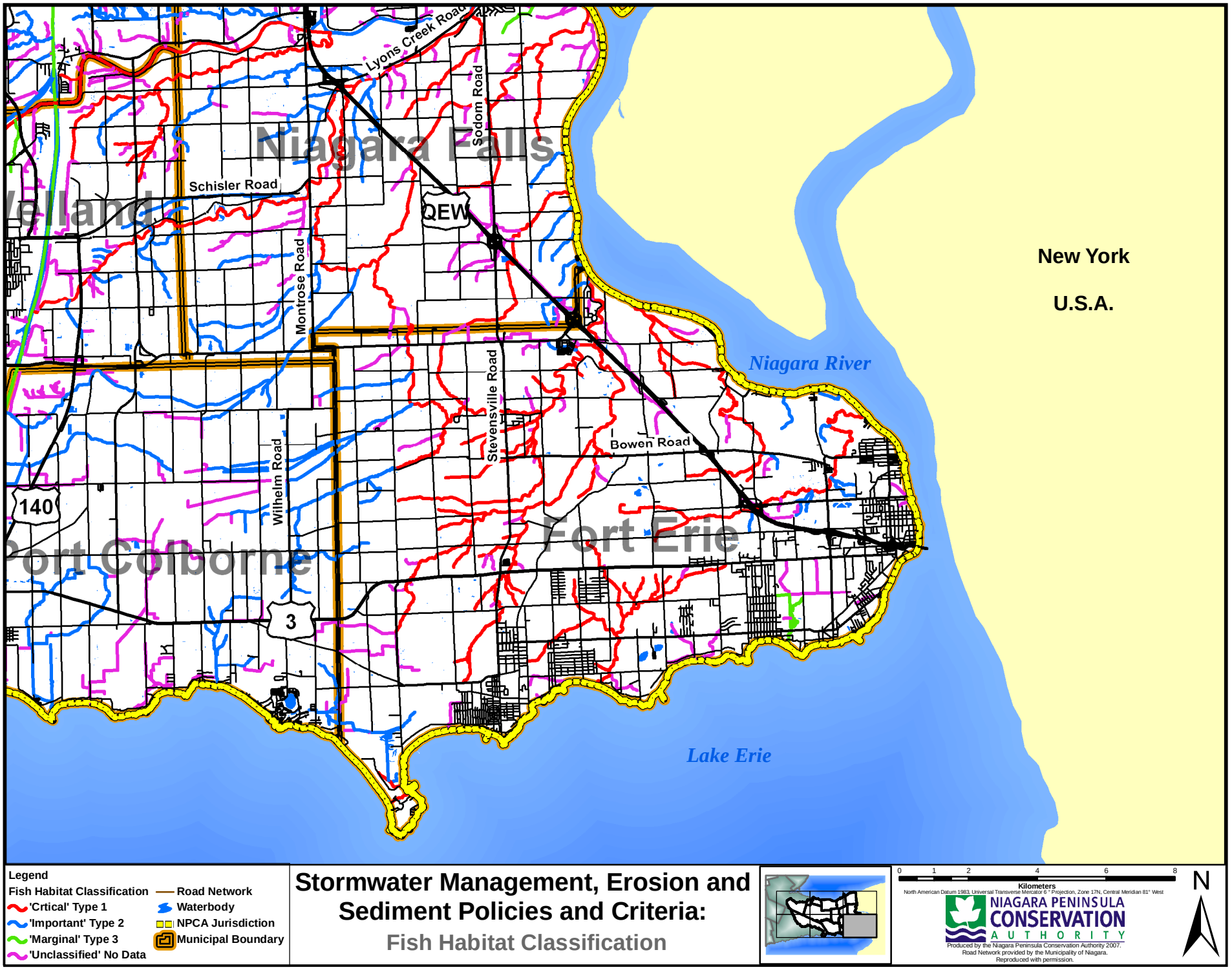

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- Waterbody
- NPCA Jurisdiction
- Municipal Boundary

Stormwater Management, Erosion and Sediment Policies and Criteria:

Fish Habitat Classification

0 1 2 4 6 8

Kilometers

North American Datum 1983, Universal Transverse Mercator 6 ° Projection, Zone 17N, Central Meridian 81° West

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APPENDIX G
Hydrogeological Sensitive Groundwater Area Maps

Disclaimer: This map is intended for illustrative purposes only. Figure is to be read in conjunction with the Niagara Peninsula Conservation Authority Groundwater Study Report.
Digital Mapping Sources: Base mapping features - Ministry of Natural Resources and NPCA.
Water well information - Ministry of the Environment.
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Lake Ontario

N

QEW

20

53

6

56

Town of Grimsby

City of Hamilton

Township of West Lincoln

Haldimand County

1:100,000
1 0.5 0 1 2 3
Kilometers

Map Projection: UTM NAD83 Zone 17

Legend

- Data Interpretation Boundary
- Study Area Boundary
- Municipal Boundaries
- International Boundary
- Major Highways
- Highways
- Roads
- Rivers, Streams, Creeks
- Ponds, Reservoirs, Lakes
- Wells Used in Analysis

Intrinsic Susceptibility

- High (Karst Area)
- High (Bedrock Outcrops)
- High
- Medium
- Low

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Figure 3-1.1: Shallow Intrinsic Susceptibility

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Water well information - Ministry of the Environment.
Date: February, 2005

N

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1 0.5 0 1 2 3
Kilometers

Lake Ontario

U.S.A.

Town of Niagara-on-the-Lake

City of St. Catharines

Town of Lincoln

City of Niagara Falls

City of Thorold

Town of Pelham

Township of West Lincoln

Niagara River

55

405

QEW

406

20

Map Projection: UTM NAD83 Zone 17

Legend

- Data Interpretation Boundary
- Study Area Boundary
- Municipal Boundaries
- International Boundary
- Major Highways
- Highways
- Roads
- Rivers, Streams, Creeks
- Ponds, Reservoirs, Lakes
- Wells Used in Analysis

Intrinsic Susceptibility

- High (Karst Area)
- High (Bedrock Outcrop)
- High
- Medium
- Low

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Figure 3-1.2: Shallow Intrinsic Susceptibility

City of Thorold

Town of Pelham

City of Welland

City of Niagara Falls

U.S.A.

Niagara River

N

Township of Wainfleet

City of Port Colborne

3

Town of Fort Erie

Lake Erie

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1 0.5 0 1 2 3

Kilometers

Map Projection: UTM NAD83 Zone 17

Legend

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- Study Area Boundary
- Municipal Boundaries
- International Boundary
- Major Highways
- Highways
- Roads
- Rivers, Streams, Creeks
- Ponds, Reservoirs, Lakes
- Wells Used in Analysis
- Water Well Record Data Gap

Intrinsic Susceptibility

- High (Karst Area)
- High (Bedrock Outcrop)
- High
- Medium
- Low

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Figure 3-1.3: Shallow Intrinsic Susceptibility

Township of West Lincoln

Haldimand County

Township of Wainfleet

Lake Erie

56 3 20 3

N

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1 0.5 0 1 2 3
Kilometers

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Map Projection: UTM NAD83 Zone 17

Legend

- Data Interpretation Boundary
- Study Area Boundary
- Municipal Boundaries
- International Boundary
- Major Highways
- Highways
- Roads
- Rivers, Streams, Creeks
- Ponds, Reservoirs, Lakes
- Wells Used in Analysis
- Water Well Record Data Gap

Intrinsic Susceptibility

- High (Karst Area)
- High (Bedrock Outcrop)
- High
- Medium
- Low

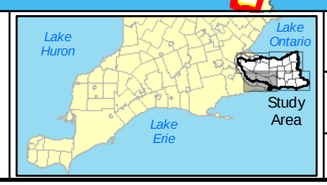

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Figure 3-1.4: Shallow Intrinsic Susceptibility

Township of West Lincoln

Town of Pelham

City of Thorold

City of Welland

Township of Wainfleet

N

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0 0.25 0.5 1 1.5 2

Kilometers

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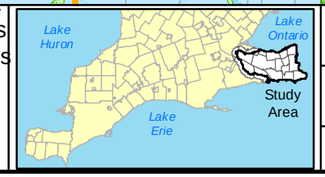
- Data Interpretation Boundary
- Study Area Boundary
- Municipal Boundaries
- Hydrogeo. Sensitive Area
- Highways
- Roads
- Rivers, Streams, Creeks
- Ponds, Reservoirs, Lakes
- Wetlands
- Sand and Gravel Pit
- Quarry
- Active Landfills
- Closed Landfills
- Waste Sites
- PCBs
- Fuel Storage
- Cemeteries
- Lumber Yards
- Hazardous Waste Receiver
- Automotive/ Machinery
- Pipeline Transfer Stations
- Pipelines
- Salt Storage Domes
- Golf Courses

Map Projection: UTM NAD83 Zone 17

- Large Sewage Systems
- Sewage/Septic Systems

Intrinsic Susceptibility
Low Medium High

96 00 01 02 03 Biosolids



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NIAGARA PENINSULA CONSERVATION AUTHORITY

Figure 5-4: Fonthill Hydrogeologically Sensitive Area

City of Welland

Township of Wainfleet

City of Port Colborne

3

Lake Erie

N

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0 0.25 0.5 1 1.5 2

Kilometers

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Map Projection: UTM NAD83 Zone 17

- Data Interpretation Boundary
- Study Area Boundary
- Municipal Boundaries
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- Highways
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- Rivers, Streams, Creeks
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- Sand and Gravel Pit
- Quarry
- Active Landfills
- Closed Landfills
- Waste Sites
- PCBs
- Fuel Storage
- Cemeteries
- Lumber Yards
- Hazardous Waste Receiver
- Automotive/ Machinery
- Pipeline Transfer Stations
- Pipelines
- Salt Storage Domes
- Golf Courses
- Septic System Problem Areas
- Large Sewage Systems
- Sewage and Septic Systems
- Intrinsic Susceptibility
  - Low
  - Medium
  - High
- Biosolids
  - 96
  - 00
  - 10
  - 20
  - 30

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Figure 5-5 : Onondaga West Hydrogeologically Sensitive Area

City of Port Colborne

Town of Fort Erie

Lake Erie

N

1:50,000

0 0.25 0.5 1 1.5 2

Kilometers

Disclaimer: This map is intended for illustrative purposes only. Figure is to be read in conjunction with the Niagara Peninsula Conservation Authority Groundwater Study Report.
Digital Mapping Sources: Base mapping features - Ministry of Natural Resources and NPCA.
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Map Projection: UTM NAD83 Zone 17

- Data Interpretation Boundary
- Study Area Boundary
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- Sand and Gravel Pit
- Quarry
- Active Landfills
- Closed Landfills
- Waste Sites
- PCBs
- Fuel Storage
- Cemeteries
- Lumber Yards
- Hazardous Waste Receiver
- Automotive/ Machinery
- Pipeline Transfer Stations
- Pipelines
- Salt Storage Domes
- Golf Courses
- Septic System Problem Areas
- Large Sewage Systems
- Sewage and Septic Systems

Intrinsic Susceptibility
Low Medium High

Biosolids
99 100 101 102 103

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Figure 5-6 : Onondaga East Hydrogeologically Sensitive Area

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N

1:50,000

0 0.25 0.5 1 1.5 2
Kilometers

Lake Ontario

U.S.A.

Niagara River

55

Town of Niagara-on-the-Lake

City of St. Catharines

- Data Interpretation Boundary
- Study Area Boundary
- Municipal Boundaries
- Hydrogeo. Sensitive Area
- Highways
- Roads
- Rivers, Streams, Creeks
- Ponds, Reservoirs, Lakes
- Wetlands
- Sand and Gravel Pit
- Quarry
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- Closed Landfills
- Waste Sites
- PCBs
- Fuel Storage
- Cemeteries
- Lumber Yards
- Hazardous Waste Receiver
- Automotive/ Machinery
- Pipeline Transfer Stations
- Pipelines
- Salt Storage Domes
- Golf Courses
- Septic System Problem Areas
- Large Sewage Systems
- Sewage and Septic Systems

Intrinsic Susceptibility
Low Medium High

99 00 01 02 03 Biosolids

Map Projection: UTM NAD83 Zone 17

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Figure 5-7: Niagara-on-the-Lake Hydrogeologically Sensitive Area

APPENDIX H
IDF Curves

The rainfall intensity is generally taken from Intensity Duration Frequency (IDF) curves derived for the study area from historical rainfall data (see Section 8.3) at a nearby rain gauge. **Table 8.2** gives some sample standard IDF coefficients (a, b, c) for three locations in the Niagara Region where the intensity can be calculated using:

$$i = \frac{a}{(t_c + b)^c}$$

Table 8.1.2
Sample IDF coefficients in the Niagara Region

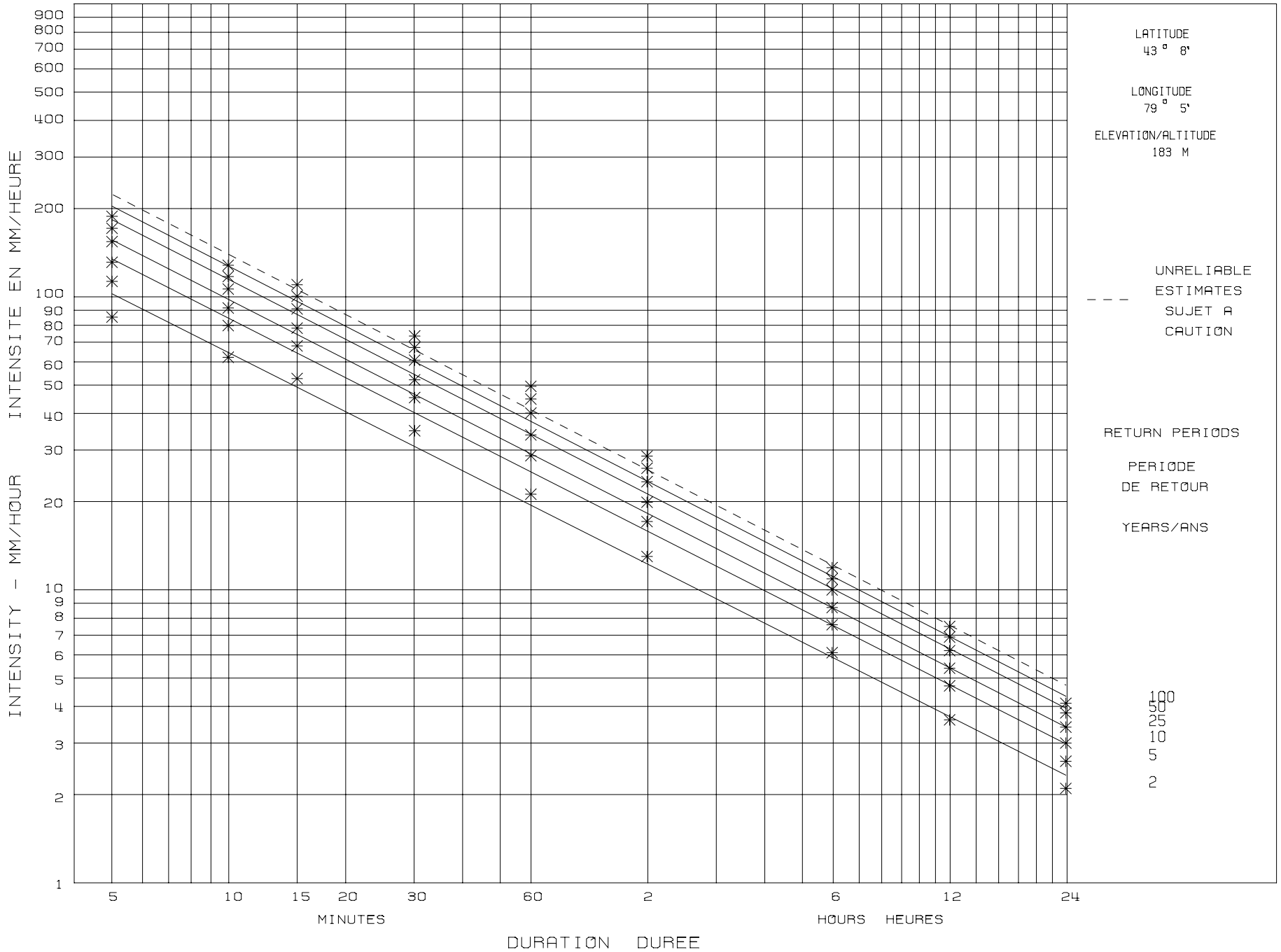
Location	Storm Frequency (years)	a	b	c
St. Catherines	2	567	5.2	0.746
	5	664	4.7	0.744
	10	724	4.3	0.739
	25	821	4.0	0.735
	50	900	3.8	0.734
	100	980	3.7	0.732
Welland	2	755	8	0.789
	5	830	7.3	0.777
	10	860	6.5	0.763
	25	900	5.2	0.745
	50	960	5.1	0.736
	100	1020	4.7	0.731
Niagara Falls	2	521.97	5.28	0.7588
	5	719.50	6.34	0.7687
	10	577.93	2.483	0.669
	25	1020.69	7.29	0.779
	100	1264.57	7.72	0.7814
Grimsby	2	603.25	6.00	0.79
	5	785.59	6.00	0.79
	10	953.64	7.00	0.79
	25	1119.02	7.00	0.79
	50	1301.80	8.00	0.80
	100	1426.13	8.00	0.80

Additional IDF curves generated by Environment Canada can be found on the following pages.

SHORT DURATION RAINFALL INTENSITY-DURATION FREQUENCY DATA FOR-
DONNEES SUR L'INTENSITE,LA DUREE ET LA FREQUENCE DES CHUTES DE PLUIE DE COURTE DUREE A NIAGARA FALLS ONT

GUMBEL-METHOD OF MOMENTS
METHODE DES MOMENTS

BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD-
BASEES SUR LES DONNEES DU PLUVIOGRAPHES POUR LA PERIOD 1965 - 1990 26 YEARS/AN



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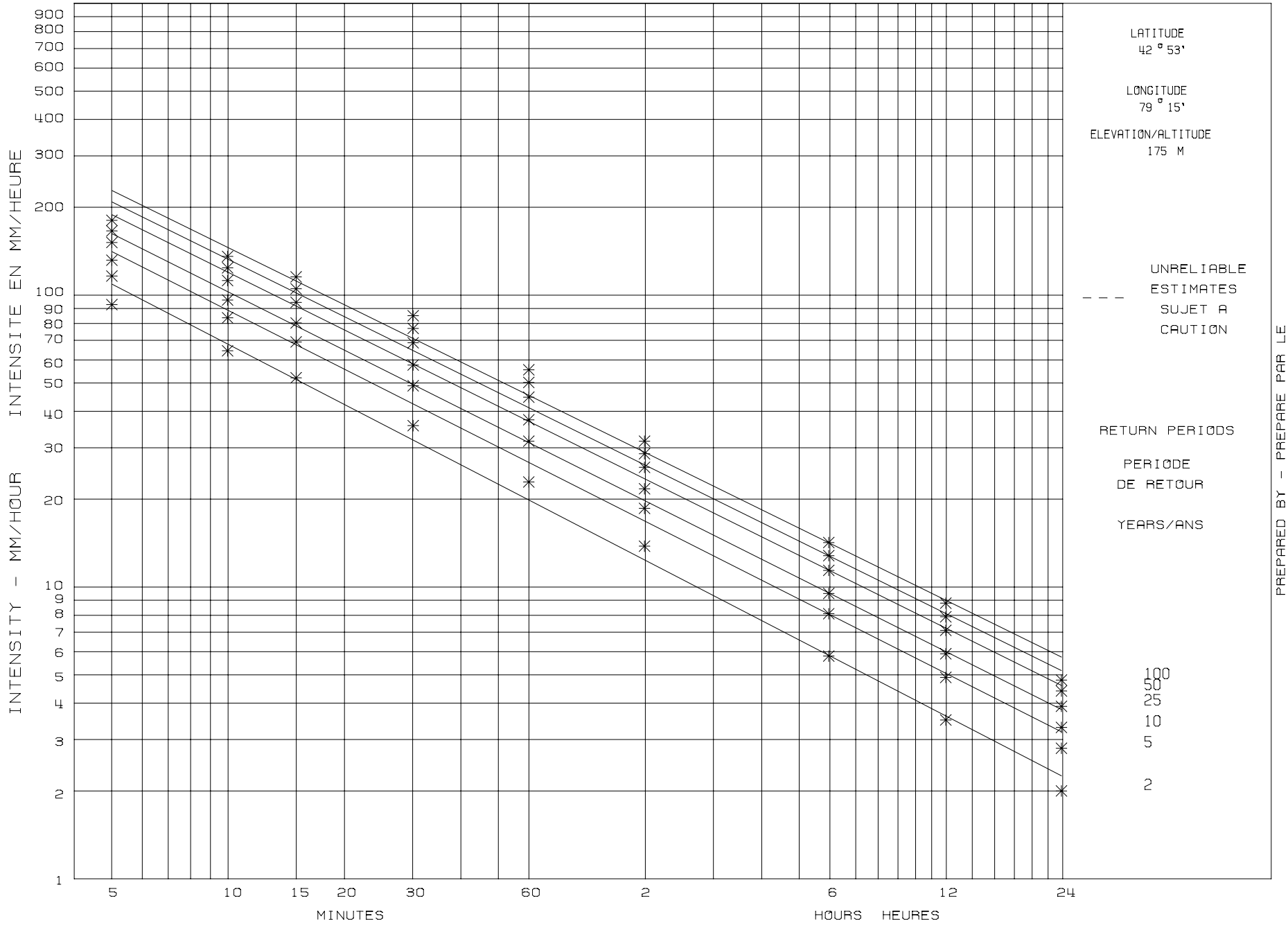
ATMOSPHERIC ENVIRONMENT SERVICE - ENVIRONMENT CANADA
SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE - ENVIRONNEMENT CANADA

SHORT DURATION RAINFALL INTENSITY-DURATION FREQUENCY DATA FOR- PORT COLBORNE ONT

DONNEES SUR L'INTENSITE,LA DUREE ET LA FREQUENCE DES CHUTES DE PLUIE DE COURTE DUREE A

GUMBEL-METHOD OF MOMENTS — BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD- 1964 - 2000 35 YEARS/AN

METHODE DES MOMENTS — BASEES SUR LES DONNEES DU PLUVIOGRAPHES POUR LA PERIOD



PREPARED BY - PREPARE PAR LE

ATMOSPHERIC ENVIRONMENT SERVICE - ENVIRONMENT CANADA

SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE - ENVIRONNEMENT CANADA

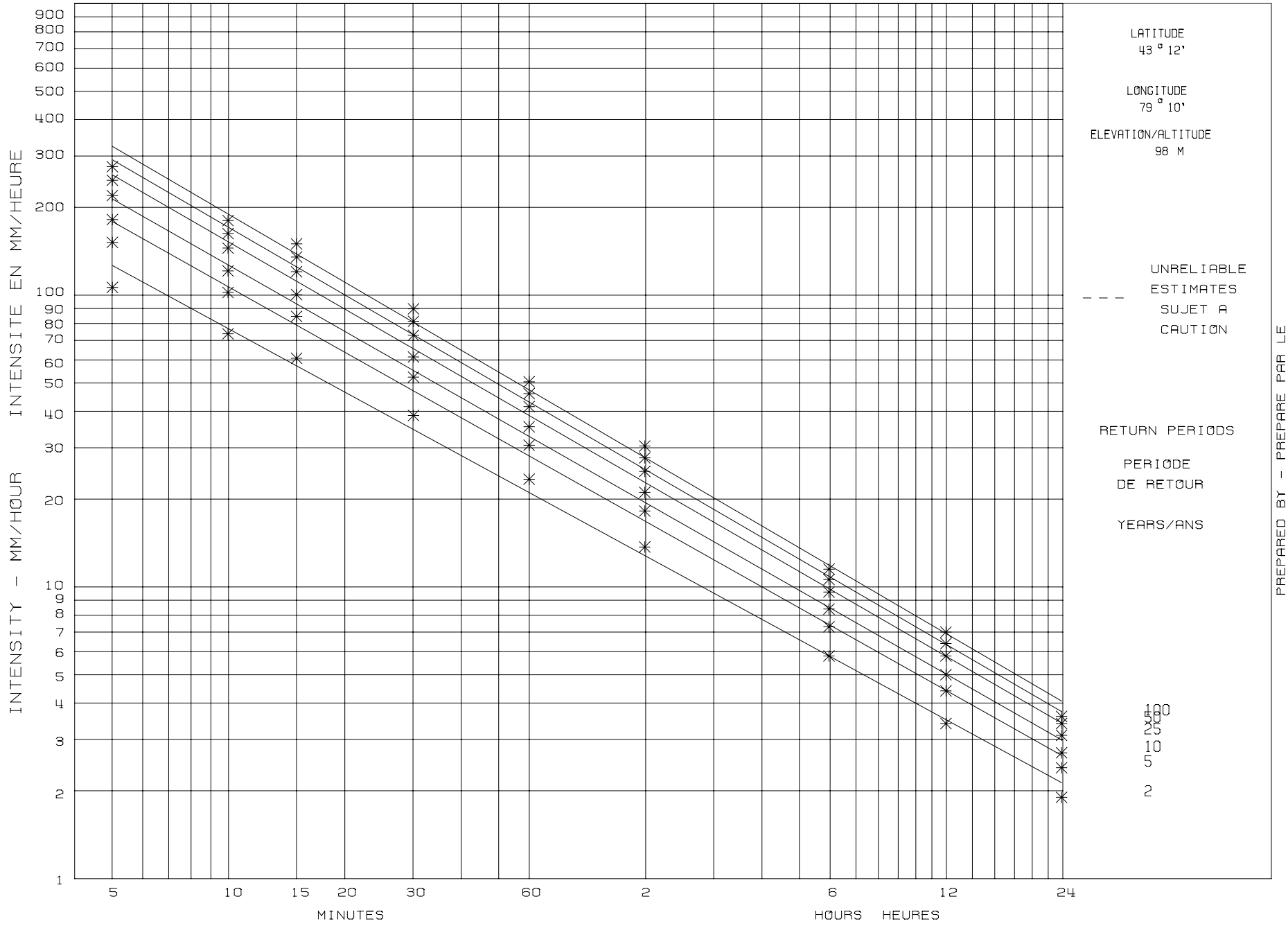
SHORT DURATION RAINFALL INTENSITY-DURATION FREQUENCY DATA FOR-
DONNEES SUR L'INTENSITE,LA DUREE ET LA FREQUENCE DES CHUTES DE PLUIE DE COURTE DUREE A

ST CATHARINES A (Composite) ONT

1954 - 2003 37 YEARS/AN

GUMBEL-METHOD OF MOMENTS
METHODE DES MOMENTS

BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD-
BASEES SUR LES DONNEES DU PLUVIOGRAPHES POUR LA PERIOD



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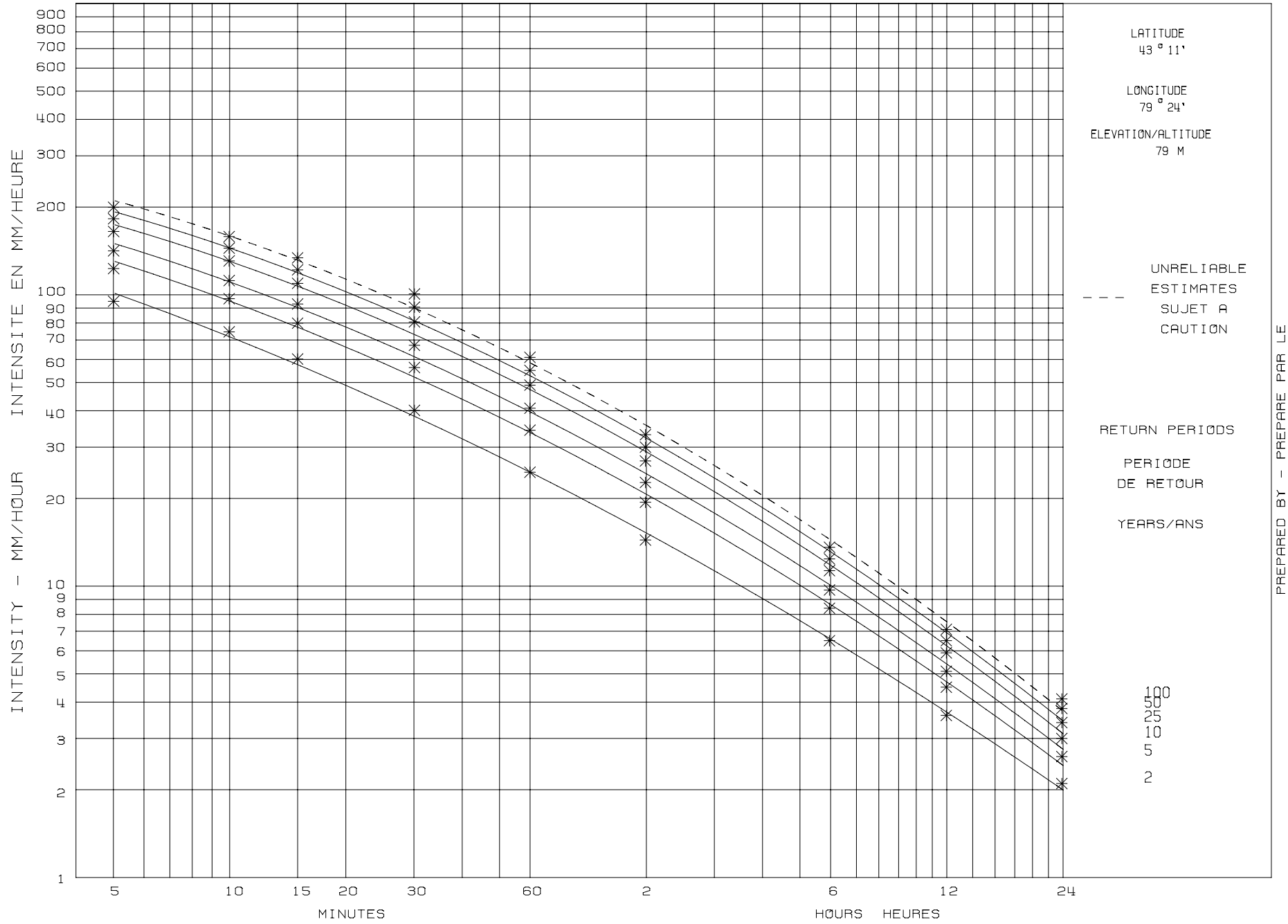
SHORT DURATION RAINFALL INTENSITY-DURATION FREQUENCY DATA FOR-
DONNEES SUR L'INTENSITE,LA DUREE ET LA FREQUENCE DES CHUTES DE PLUIE DE COURTE DUREE A

VINELAND STATION RCS ONT
(Composite)
1963 - 2003 23 YEARS/AN

GUMBEL-METHOD OF MOMENTS
METHODE DES MOMENTS

BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD-
BASEES SUR LES DONNEES DU PLUVIOGRAPHES POUR LA PERIOD



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APPENDIX I
Sample Stormwater Management Aesthetic Guidelines

TOWN OF NIAGARA-ON-THE-LAKE

POLICY

POLICY NO. **PW-DRA-004A**
SUPERSEDES NO. PW-DRA-004

TITLE: ***Landscape & Maintenance Guidelines for Stormwater Management Ponds & Facilities***

APPROVAL DATE: **April 10, 2006**
EFFECTIVE DATE: **April 11, 2006**

PURPOSE:

To establish a landscaping ***and maintenance*** policy for open storm water management pond facilities.

POLICY STATEMENT:

Landscaping designs for storm water management ponds must create a generally safe yet natural environment, incorporate a cost effective water resources management approach, be consistent with the ecosystem, aesthetically pleasing, ecologically diverse and provide passive and active pursuits when they can be incorporated with a larger overall community or area plan.

The following details are to be followed:

1. Generally the overall grading of the pond will be in accordance with current Ministry of the Environment and Niagara Peninsula Conservation Authority requirements.

2. The landscape materials (trees, shrubs & plants) shall be planted in accordance to the attached profile drawing identified as Appendix "A", and cover a minimum of 25% of the facility area (excluding permanent pool area).

3. The landscape materials shall conform to the following:
a) The entire facility area shall have a minimum of 50 mm of topsoil, and hydro seeded with the following grass mixture, at a rate of 2.0kg/100m2.
30% Tall Fescue (Festuca arundinacea)
30% Creeping Red Fescue (Festuca rubra)
15% Perennial Ryegrass (Lolium perenne)
15% Birdsfoot Treefoil (Lotus corniculatus)
5% Annual Ryegrass (Lolium multiflorum)

5% White Clover (Trifolium repens)

b) Upland/Floodfringe Planting: Plantings shall consist of native tree species identified in Appendix "B". The combinations and density of the plantings will also have regard for the adjacent land uses.

c) Shoreline Fringe: Plantings shall consist of native tree species identified in Appendix "C".

d) Aquatic Fringe: Plantings shall consist of plant species identified in Appendix "D".

4. Fencing, consisting of black vinyl chain link materials 1.5m in height will be provided adjacent to residential lots. ***Where the safety risk can be minimized, preference will be given to a natural barrier, consisting of a dense perimeter vegetation together with flatter pond side slopes noted in # 5.*** The vegetation may consist of strategically planted thorn-bearing trees and shrubs such as hawthorn and raspberry. However, fencing may be necessary in critical areas such as headwalls or in other areas with significant changes in grade.

5. Walkways, trails and other amenities such as fountains, benches, and rock walls may be incorporated into the facility design when the facility is an integral part of an overall trail/pedestrian system or adjacent to a municipal park. In cases where trails and other amenities are incorporated into the facility, the following design parameters ***and requirements*** must be provided:

i) Paths shall not be located lower than the 5-year storm event water elevation.

ii) A minimum buffer of 5m from 0.3m above the 100 year storm elevation to the property line.

iii) Side slopes adjacent to wet facilities must be 5:1 maximum and for dry facilities 4:1 maximum.

iv) Facility must be posted to warn public of potential safety hazards relating to the operation of the facility.

v) Identify extra life cycle maintenance costs associated with these amenities.

6. The facility shall display a sign, appropriately located, identifying the facility purpose, maintenance level, and municipal phone number.

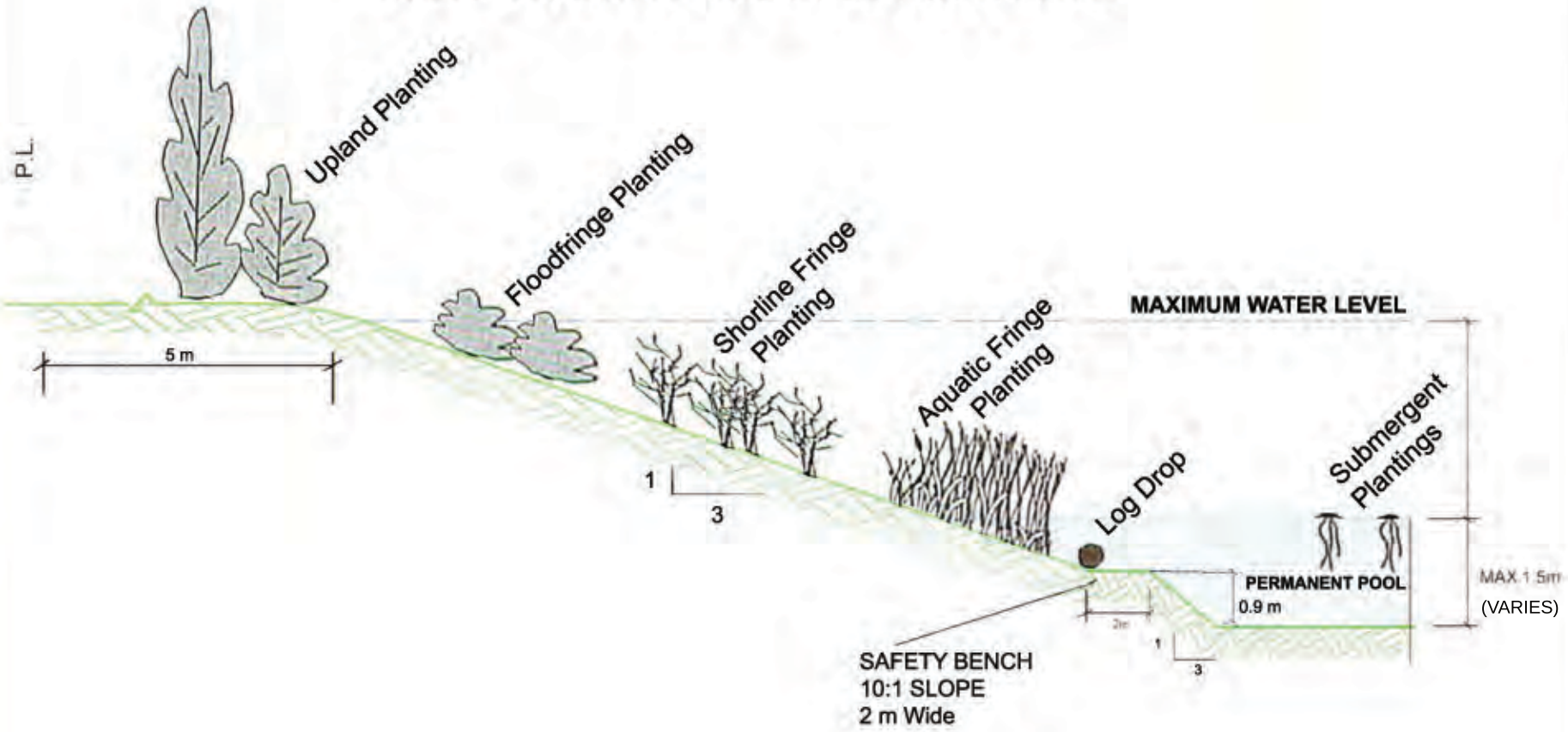
7. The landscape plan, ***including amenities, if applicable,*** must be prepared by a qualified Landscape Architect, reviewed by the Public Works and Parks & Recreation Departments, and approved by ***Council.***

8. The maintenance of the facility shall be carried out by the Town's Public Works Department and primarily consist of grass mowing, and litter cleanup on a monthly basis, April to October. Additional maintenance to the landscape materials, fencing and other

amenities shall be carried out as required.

9. The facility inlet and outlet structures together with the downstream watercourse shall be inspected annually and repaired as required.

APPENDIX "A"
BASIN CROSS-SECTION AND LANDSCAPING



NOT TO SCALE

APPENDIX "B"

Upland Plantings/ Floodfringe Plantings: shall consist of native tree species from among:

Acer rubrum	Red Maple
Acer saccharum	Sugar Maple
Betula nigra	River Birch
Carya cordiformis	Bitternut Hickory
Carya glabra	Pignut Hickory
Carya ovata	Shagbark Hickory
Carya tomentosa	Mockernut Hickory
Cercis canadensis	Eastern Redbud
Celtis occidentalis	Hackberry
Fraxinus americana	White Ash
Fraxinus nigra	Black Ash
Fraxinus pennsylvanica	Green Ash
Fraxinus quadrangulata	Blue Ash
Liquidambar styraciflua	Sweet Gum
Liriodendron tulipifera	Tulip Tree
Nyssa sylvatica	Tupelo
Platanus occidentalis	Sycamore
Quercus alba	White Oak
Quercus bicolor	Swamp White Oak
Quercus macrocarpa	Bur Oak
Quercus palustris	Pin Oak
Quercus rubra	Red Oak

In addition, coniferous trees such as

Abies concolor	White Fir
Juniperus virginiana	Eastern Red Cedar
Larix laricina	Tamarack
Picea glauca	White Spruce
Pinus strobus	White Pine
Thuja occidentalis	Eastern White Cedar

should be combined with the deciduous species noted above.

APPENDIX "C"

Shoreline Fringe Plantings: the plantings shall consist of

Trees

Acer rubrum	Red Maple
Betula nigra	River Birch
Fraxinus nigra	Black Ash
Fraxinus pennsylvanica	Green Ash
Larix laricina	Tamarack
Nyssa sylvatica	Tupelo
Platanus occidentalis	Sycamore
Populus tremuloiodes	Trembling Aspen
Quercus bicolor	Swamp White Oak
Quercus macrocarpa	Bur Oak
Quercus palustris	Pin Oak
Salix Discolor	Pussy Willow

Shrubs

Aronia arbutifolia	Red Chokeberry
Aronia melanocarpa	Black Chokeberry
Alnus rugosa	Speckled Alder
Cephalanthus occidentalis	Buttonbush
Cornus stolonifera	Red Osier Dogwood
Physocarpus opulifolius	Ninebark
Sambucus canadensis	Elderberry
Viburnum cassinoides	Northern Wild Raisin
Viburnum dentatum	Arrowwood
Viburnum lentago	Nannyberry
Viburnum trilobum	Highbush Cranberry
Prunus virginiana	Chokecherry

Grasses and Herbaceous

Andropogon gerardii	Big Bluestem
Aster novae- angliae	New England Aster
Aster pilosus	Hairy Aster
Aster umbellatus	Flat- topped aster
Aster urophyllus	Arrow- leaved aster
Echinacea purpurea	Purple Coneflower
Eupatorium maculatum	Joe Pye Weed
Eupatorium perfoliatum	Boneset
Eupatorium purpureum	Purple Joe Pye Weed
Liatris spicata	Dense Blazing Star

Lilium michiganese	Michigan Lily
Lobelia spicata	Pale- spiked Lobelia
Monarda fistulosa	Wild Bergamot
Panicum virgatum	Switchgrass
Ratibida pinnata	Yellow Coneflower
Rudbeckia hirta	Black Eyed Susan
Rudbeckia laciniata	Green- headed Coneflower
Solidago graminifolia	Lance- leaved Goldenrod
Solidago rigida	Stiff Goldenrod
Solidago rugosa	Rough- stem Goldenrod
Solidago speciosa	Showy Goldenrod
Veronicastrum virginicum	Culver's Root

APPENDIX "D"

Aquatic Fringe Plantings: the plantings shall consist of

Trees

Acer rubrum	Red Maple
Alnus rugosa	Speckled Alder
Betula nigra	River Birch
Fraxinus nigra	Black Ash
Fraxinus pennsylvanica	Green Ash
Larix laricina	Tamarack
Nyssa sylvatica	Tupelo
Populus tremuloides	Trembling Aspen
Quercus macrocarpa	Bur Oak
Quercus palustris	Pin Oak
Quercus bicolor	Swamp White Oak
Salix discolor	Pussy Willow

Shrubs

Aronia arbutifolia	Red Chokeberry
Aronia melanocarpa	Black Chokeberry
Cephalanthus occidentalis	Buttonbush
Cornus ammmonum	Silky Dogwood
Cornus stolonifera	Red Osier Dogwood
Ribes americanum	American Black Currant
Rubus strigosus	American Red Raspberry
Salix bebbiana	Bebb Willow
Salix exigua	Sandbar Willow
Salix lucida	Shining Willow
Salix petiolaris	Slender Willow
Salix pyrifolia	Balsam Willow
Viburnum cassinoides	Witherod Viburnum

Grasses and Herbaceous

Asclepias incarnata	Swamp Milkweed
Aster puniceus	Swamp Aster
Carex aquatilis	Water Sedge
Carex bebbii	Bebb's Sedge
Carex comosa	Bottlebrush Sedge
Carex crinita	Fringed Sedge
Carex lacustris	Lake Sedge
Carex lucida	Sallow Sedge

Carex ligosperma	Few- seeded Sedge
Carex pseudo- cyperus	Cyperus- like Sedge
Carex stipata	Awl- fruited Sedge
Carex stricta	Tussock Sedge
Carex tuckermanii	Tuckerman's Sedge
Carex vulpinoidea	Fox Sedge
Decodon verticillatus	Swamp Loosestife
Eupatorium maculatum	Joe Pye Weed
Eupatorium perfoliatum	Boneset
Eupatorium purpureum	Purple Joe Pye Weed
Gentiana andrewsii	Bottle Gentian
Glyceria striata	Fowl Manna Grass
Helenium autumnale	Sneezeweed
Hibiscus moscheutos	Marsh Hibiscus
Hierochloe odorata	Sweet Grass
Iris versicolor	Blue Flag Iris
Juncus articulatus	Jointed Rush
Juncus canadensis	Canada Rush
Juncus effusus	Soft Rush
Juncus pelocarpus	Brown Fruited Rush
Juncus torreyi	Torrey's Rush
Leersia orzoides	Rice Cut Grass
Liatris spicata	Dense Blazing Star
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Blue Lobelia
Lobelia kalmii	Kalm's Lobelia
Ratibida laciniata	Green- headed Coneflower
Scirpus acutus	Hardstem Bullrush
Scirpus atrovirens	Green Bullrush
Scirpus cyperinus	Wool Grass Bullrush
Scirpus fluviatilis	River Bullrush
Scirpus pendulus	Pendulus Bullrush
Scirpus pungens	Common Three Square Bullrush
Scirpus validus	Softstem Bullrush
Spartina pectinata	Prairie Cordgrass
Verbena hastata	Blue Vervain
Vernonia fasciculata	Ironweed
Veronicastrum virginicum	Culver's Root

STORM WATER MANAGEMENT
FACILITIES DESIGN PRINCIPLES

PURPOSE: ***"To achieve the highest level of utilization, aesthetics, environmental benefits and ease of maintenance".***

FOR SUBDIVISIONS AND SITE PLANS:

1. a) Storm water management areas for subdivisions will be on lands dedicated to the City in addition to any lands required to be dedicated for park purposes under the Planning Act.

   b) Storm water management areas for site plans will be on lands retained by the owner. All costs associated with the construction and continuing maintenance of storm water management facilities shall be borne by the owner.

2. Storm water management **DRY PONDS** shall be designed to limit the maximum depth of water to 1.8m above the lowest point of the storm water basin. An additional 0.3m free board is required above the maximum peak flow flood level. The maximum depth of the extended detention zone shall not exceed 1.0m above the lowest point of the pond. Maximum peak flow attenuation shall be limited to an additional 0.8m (see Figure 1).

   a) A maximum 5:1 slope shall extend from the bottom of the pond to the limit of maximum extended detention, with a minimum horizontal length of 3.0m. The minimum allowable gradient on the bottom of the basin shall be 1.0%, and the maximum gradient shall be 5.0%.

3. Storm water management **WETLANDS** shall be designed to limit the maximum depth of water to 2.1m above the lowest point of the storm water basin. An additional 0.3m freeboard is required above the maximum peak flow flood level. The maximum depth of the extended detention zone shall not exceed 1.0m above the permanent pool elevation. Maximum peak flow attenuation shall be limited to an additional 0.8m. The permanent pool depth shall range between a minimum depth of 0.15m to a maximum depth of 0.3m (see Figure 1).

   a) A maximum 5:1 slope below the permanent pool level shall be required around the entire storm water management pond.

   b) A maximum 5:1 slope above the permanent pool level shall be required around the entire storm water management pond. The slope shall extend from the permanent pool level, to the limit of maximum extended detention. The horizontal distance of this slope must be a minimum of 3.0m.

   c) Where required, micropools shall have an additional maximum depth of 0.3m below the permanent pool level. Micropools shall not exceed 5% of the total Wetland surface area (see Figure 2).

4. Storm water management **WET PONDS** shall be designed to limit the maximum depth of water to 3.3 m above the lowest point of the storm water basin. An additional 0.3m freeboard is required above the maximum peak flow flood level. The maximum depth of the extended detention zone shall not exceed 1.0m above the permanent pool elevation. Maximum peak flow attenuation shall be limited to an additional 0.8m. The permanent pool depth shall range between a minimum depth of 1.0m to a maximum depth of 1.5m (see Figure 1).

a) A maximum 5:1 slope below the permanent pool level shall be required around the entire storm water management pond. The horizontal distance of this slope must be a minimum of 3.0m. A slope commencing from this point to the lowest point of the storm water basin shall be a maximum of 3:1.

b) A maximum 5:1 slope above the permanent pool level shall be required around the entire storm water management pond. The slope shall extend from the permanent pool level, to the limit of maximum extended detention. The horizontal distance of this slope must be minimum of 3.0m.

c) The use of **WET PONDS** for site plans will not be permitted.

5. Where forebays are required, the permanent pool depth shall range between a minimum depth of 1.0m to a maximum depth of 1.5m in which a maximum depth of 0.5m shall be used for sediment accumulation. Forebays shall not exceed 33% of the total pond surface area. All other aspects regarding the design of forebays shall conform to the above Wet Pond standards. Excluding maintenance access routes, all access to forebays shall be discouraged through shrub plantings (see Figure 3).

6. From the point of maximum extended detention, to the lower limits of the "Safety Separation" area or property line where it abuts private property, slopes shall vary between 2:1 to 6:1, and have a maximum average slope of 4:1, not including the maximum 10:1 maintenance access slope.

7. For Wet Ponds and Wetlands, all slopes 5:1 and steeper ranging from a minimum horizontal distance of 3.0m from the permanent pool level to the property line (not including easements, walkways, and trails), shall be vegetated with shrubs, trees and low maintenance ground cover. For Dry Ponds, all slopes 5:1 and steeper, ranging from a minimum horizontal distance of 3.0m from the pond bottom level to the property line (not including easements, walkways, and trails), shall be vegetated with shrubs, trees and low maintenance ground cover. In areas where shrubs and trees are not permitted or warranted, low maintenance ground cover is required.

8. Shrubs and trees shall be native species and ground cover is to be of a low maintenance variety (see Appendix A).

9. Where trees are to be planted, they must be planted at a minimum rate of 1 tree per 50 square metres. The density of shrub plantings shall vary depending on the degree of slope. Shrub plantings shall prevent public access through all 2:1 slopes for safety purposes. Access through 3:1 slopes shall be discouraged through coverage intensity of shrub plantings.

* The density of vegetation should vary according to the degree of slope. The purpose of the bar scale is not to encourage repetitive landscape design, however, to act as a relative guide to associate shrub plant densities with the appropriate slope.

10. Designed pedestrian access areas shall require a maximum slope of 6:1.

11. Fencing of storm water management facilities shall be discouraged however, may be required as determined by the City.

12. Notwithstanding policies 2, 2(a), 3, 3(a), 3(b), 3(c), 4, 4(a), 4(b), 5, and 11 above, in the case of headwall designs, the depth of water related to adjoining side slopes may vary, and fencing may be required for safety purposes.

13. A Landscape Plan to the approval of the Manager of Community Arenas, Athletics, Design and Development, will be required prior to the Plan of Subdivision registration. All required landscaping above the 5 year storm level, in accordance with the approved plan, shall be installed at the Developer's cost during the first planting season after final grading of the storm water management pond is completed. The remainder of the planting shall commence at the direction of the Department of Parks and Recreation, at the Developer's cost. The Developer shall maintain the pond for a minimum of two years once final planting is complete. Landscape Plans are to be prepared by a Landscape Architect (see Appendix A & B).

14. That in all cases, implementation of these policies and guidelines shall have regard for approved Watershed, Sub-Watershed, and Master Drainage Plans.

FOR SUBDIVISIONS ONLY:

In addition to clauses 1 to 14, the following policies shall apply to subdivisions only:

15. Community trails where they have been identified and required by the City, shall be implemented above the maximum extended detention level, or 5 year storm level, in order to prevent frequent flooding. Trails shall have a minimum width of 3.0m.

16. To enhance user comfort and safety, a 3.0m zone on each side of the community trail shall be designed in such a way that sightlines are preserved. If barriers are required, they must not interfere with visibility or create entrapment areas. In situations where a community trail is designed within the maximum peak flow depth zone, the 3.0m separation above the trail shall have a maximum slope of 3:1. Below the trail, the 3.0m separation shall have a maximum slope of 6:1. This zone shall be planted with low ground covers (see Figure 4).

* Deciduous tress should be planted at a minimum distance of 1.5m from the edge of the trail. Maintenance is required to ensure that tree canopies are raised to a minimum of 2.2m, and shrubs must be regularly prevented from naturalizing this zone. The planting of coniferous trees within this zone is not recommended.

17. Maintenance access routes shall be provided to both inlet and outlet structures and forebays. A minimum 3.0m wide, hard surfaced access with a minimum 10m turning radius (inside radial), and a flat 10m loading area is required. Maintenance access routes shall require a maximum slope of 10:1. The design of maintenance routes and loading areas shall be to the approval of the Department of Public Works.

18. An information sign posted at an appropriate location such as a public access point, detailing the purpose of the pond, phone number for further information, and any other relevant information is required for all storm water management facilities (see Figure 6). All costs associated with the provision of the sign shall be borne by the Developer. Sign details shall be approved to the satisfaction of the Manager of Community Arenas, Athletics, Design and Development. Depending on the size of the storm water management facility and number of public access points, multiple signs may be required as determined by the City.

19. In order to prevent surcharging of storm sewers upstream, storm sewer pond inlet inverts shall not be lower than the maximum 5 year storm level, or the maximum extended detention level; which ever is greater in elevation (see Figure 5).

FOR SITE PLANS ONLY:

In addition to Clauses 1 to 14, the following policies shall apply to site plans only:

20. The placement of children's play equipment shall not be permitted within storm water management facilities.

21. Storm water **QUANTITY** management strategies can be accommodated within parking areas to a limit of 0.3m in depth.

22. Storm water **QUALITY** management strategies can not be accommodated within parking areas. Oil grit separators may only be used in conjunction with alternate methods for water quality management.

23. Where appropriate, areas subject to the collection of contaminants or spills shall be fitted with adequate oil/grit separators.

24. Rooftop storage shall be considered as a storm water management option and shall be infiltrated as appropriate.

25. In cases where storm water management facilities can not be aesthetically accommodated above ground, underground storage shall be considered as an alternative option.

APPENDIX J
Sample Sediment and Erosion Control Inspection Form

Sample Erosion and Sediment Control Inspection Form #1
(GTACA, 2006)

Erosion and Sediment Control Inspection Report
(SAMPLE)

Project: _____
Project No./Contract No.: _____
Permit No.: _____

Prime Contractor: _____

Inspector: _____
Inspector Qualifications: _____
Verbal/Written Notification given to: _____

Stage of Construction: _____

Construction Activities on Site: _____
Heavy Equipment on Site: _____

Site Area (ha.): _____
Receiving Water (i.e. creek, lake): _____

Inspection:
Date: _____

Time: _____
Duration (hours): _____
Reason for Inspection: Weekly _____
Rainfall Event _____
Snowmelt Event _____

Date of Last Inspection: _____

Current Weather Conditions: _____
Previous Weather Conditions for site: _____
Rainfall amount (mm): _____
Rainfall duration (hours): _____
Snowmelt amount (mm): _____

No. of Days Lost due to Inclement Weather: _____

Erosion and Sediment Control Measu (list measures that appear/should appear on ESC Plan)	ESC Measure Effective			Maintenance of ESC Measure(s) required			Recommended Time for Clean-up of Measure	Inspector's Comments (include location of ESC measure to be repaired)	Action(s) Required
	Yes	No	N/A	Yes	No	N/A			
Erosion Prevention Practices:									
Vegetative Filter Strip									
Seeding									
Hydro-seeding									
Terra-seeding									
Top soiling									
Sodding									
Mulching									
Re-vegetative Systems									
Tree and Shrub Plantings									
Erosion Control Matting/Blanket/Net									
Buffer/Riparian Zone Preservation									
Scarification									
Sediment Control Practices - Perimeter Controls:									
Sediment/Silt Fence							Sediment accumulation reaches 50% of geotextile height		

Erosion and Sediment Control Measu (list measures that appear/should appear on ESC Plan)	ESC Measure Effective			Maintenance of ESC Measure(s) required			Recommended Time for Clean-up of Measure	Inspector's Comments (include location of ESC measure to be repaired)	Action(s) Required
	Yes	No	N/A	Yes	No	N/A			
Interceptor Swale/Dyke									
Silt Soxx with Compost Material							Sediment accumulation reaches 50% of Soxx height.		
Mud Mat									
Vehicle Wheel washer									
Storm Drain Outfall Protection									
Sediment Control Practices - Sediment Controls:									
Ditch/Swale Sediment Traps							Sediment accumulation reaches 50% of the sediment trap height.		
Sediment Traps							Sediment accumulation reaches 50% of the sediment trap height.		
Rock Check Dams							Sediment accumulation reaches 50% of the rock check dam height.		
Sediment Control Ponds/Basins							Sediment accumulation reaches 50% of the forebay design volume.		
Bulkhead within Storm Sewers									
Sediment Control Practices - Filtration Controls:									
Drain Inlet Protection							Refer to manufacturer's instructions to confirm clean-up time.		
Sediment Bag							Refer to manufacturer's instructions to confirm clean-up time.		
In-Stream Controls:									
Auguring and Directional Drilling									
Sediment/Turbidity Curtains									
nporary Stream Crossings via Culvert(s)									
Dry Flume									
Cofferdam									
By-pass or Full Diversion									
Dewatering									

Erosion and Sediment Control Measu (list measures that appear/should appear on ESC Plan)	ESC Measure Effective			Maintenance of ESC Measure(s) required			Recommended Time for Clean-up of Measure	Inspector's Comments (include location of ESC measure to be repaired)	Action(s) Required
	Yes	No	N/A	Yes	No	N/A			
General Concerns:									
Are offsite/downstream properties/waterways protected?									
Have all deficiencies been repaired immediately after being reported?									
Does ESC Plan require revision?									
Photo inventory provided?									

Inspector's Signature: _____

Sample Erosion and Sediment Control Inspection Form #2
(Li, 1997)

Submission Erosion and Sediment Control Checklist (Li, 1997)

Part 1 – Descriptive Section

1. Project description
2. Existing site conditions
3. Adjacent areas
4. Soils
5. Critical areas
6. Erosion and Sediment Control Practices
7. Permanent stabilization
8. Stormwater Management considerations
9. Maintenance
10. Calculations
11. Controls Required for Pollutants other than Erosion and Sediment
12. Construction schedule

Part II – Site Plan

1. Vicinity maps
2. Existing contours
3. Existing vegetation
4. Soils
5. Indicate north
6. Critical erosion areas
7. Existing drainage patterns final contours
8. Limits of clearing and grading
9. Cut and fill slopes
10. Conveyance
    a) Designate locations for grass-lined swales, interceptor trenches, or ditches;
    b) Show all drainage pipes, ditches, or cut-off trenches associated with erosion/sedimentation;
    c) Provide all temporary pipe inverts or minimum slopes and cover;
    d) Show grades, dimensions, location, and direction of flow in all ditches and swales;
    e) Provide details of bypassing off-site runoff around clearing limits/disturbed areas and sediment pond/trap; and
    f) Indicate locations and outlets of any possible dewatering systems.
11. Location of erosion and sediment control practices.
12. Sediment control facilities.
    a) Show all locations of sediment traps/ponds if required and all associated pipes and structures.
    b) Dimension pond berm widths and all inside and outside pond slopes.
    c) Indicate the trap/pond storage required and the depth, length, and width dimensions.
    d) Provide typical section views throughout the pond and outlet structure.
    e) Provide typical details of gravel cone and standpipe, and/or other filtering devices.

f) Detail stabilization techniques for outlet/inlet.
g) Show control/restrictor device location and details.
h) Specify mulch and/or recommended cover for berms and slopes.
i) Provide rock specifications and detail for rock check dams, if used.
j) Specify spacing for rock check dams as required for actual slopes on the site.
k) Provide front and side sections of typical rock check dams.
l) Indicate locations and provide details and specifications for silt fabric fences (include installation detail).

13. Detailed drawings.
14. Control of Pollutants Other than Sediment.

References

GTACA (Greater Toronto Area Conservation Authorities). (2006). Erosion and Sediment Control Guideline for Urban Construction. Prepared December 2006. p. APPENDIX F.

Li, J. (1997). Erosion and Sediment Control: Training Manual. Prepared for Ontario Ministry of Environment and Energy, March 1997. pp. 1-1 – 3-23.

APPENDIX K
Sample Stormwater Management Report TOR and Submission Checklist

STORMWATER MANAGEMENT REPORT
TERMS OF REFERENCE

Study	Stormwater Management Report
Description	• To identify the quality and quantity impacts of the change in stormwater runoff on existing infrastructure and watercourses due to a proposed development. • To determine improvements to municipal servicing infrastructure required to support the proposed level of development. • To determine mitigation measures to minimize any negative impacts.
When Required	A Stormwater Management Report is required for the following application types: • Plans of Subdivision • Site Plan Control applications
Rationale	**Objective** The objective of a Stormwater Management Report is to evaluate the effects of a proposed development on the stormwater and drainage pattern, and to recommend how to manage rainwater/snowmelt for the proposed development, consistent with the City's Wet Weather Flow Management Policy and while also meeting TRCA, provincial and federal regulations. **Format** A Stormwater Management Report is prepared by a Registered Professional Engineer qualified in municipal engineering/stormwater management, and must follow the interim guidelines on preparation of Stormwater Management Reports that are currently used in each service district. The interim guidelines will be replaced by harmonized guidelines in the future. The submission must include reports, plans, computer modeling results and design calculations relating to how storm run-off is to be managed. **Process** A Stormwater Management Report is to be submitted in conjunction with the development application. The applicant is encouraged to discuss the need, scope and the proposed stormwater management concepts and design assumptions with City staff prior to preparing the report. For Plans of Subdivision, the report is to be submitted in two stages. The Preliminary Report outlines the design assumptions and conceptual engineering schemes to manage both quantity and quality of run-offs. The Preliminary Report is to be submitted when the application is initiated and must be accepted prior to draft plan approval of a Plan of Subdivision. The Final Report provides the detailed calculations and the design of the stormwater management facilities and drainage systems based on the accepted principles in the Preliminary Report, and must be accepted prior to the final approval of the Plan of Subdivision. For Site Plan Control applications, the Final Report is to be submitted in conjunction with the development application must be accepted prior to site plan approval. An Environmental Impact Study may be required to address the impact of development on water resources features or functions on and off site (see EIS Terms of Reference). **Principles** A Stormwater Management Report must be based on established stormwater management principles, best management practices, and the interim guidelines used in each service district (until they are harmonized by the Wet Weather Flow Management Technical Guidelines) and the Ministry of the Environment Policies and the Wet Weather Flow Management Policy.

	The authority to request this work is provided by the *Planning Act*, the Provincial Policy Statement, the Official Plan, the Council approved Wet Weather Flow Management Policy and Chapter 681 of the Municipal Code – Sewer.
Required Contents	A Stormwater Management Report must include the basic quantity and quality assumptions upon which the report is based, and all appropriate functional plans of infrastructure elements for major and minor flow, which could have an impact on the layout of the Plan of Subdivision. These infrastructure elements may include stormwater management facilities, all water resources features and functions (i.e., watercourses, riparian areas, recharge/discharge areas), existing overland flow routes, surface features (i.e., top of bank of valleys) and existing infrastructure (i.e., water and wastewater infrastructure and underground utilities). Where a development proposal may impact a water resources features or function, the Stormwater Management Report must incorporate into the design the recommendations from the separate Environmental Impact Study referenced above. The Preliminary Report must provide sufficient engineering information to allow for the necessary review and acceptance of the proposed stormwater management schemes in principle. This report should address the following: ▪ Identify constraints and potential opportunities – quantitative, qualitative, erosion sensitivity and environmental concerns related to water resources for both interim and ultimate development conditions, both on and off site. ▪ Identify the inlets (from upstream) and outlet (to downstream) for the minor and major systems, including overland flow routes. ▪ Identify all external drainage areas under existing and future development conditions for minor and major flows. ▪ Demonstrate that the proposal has maximized source control measures to reduce runoff from the site and maximized conveyance control measures to infiltrate and/or treat run-off as appropriate consistent with water quantity and quality objectives and targets under the Wet Weather Flow Management Policy. ▪ Indicate if off-site land or works are required to implement the stormwater management proposals and comment to what extent (e.g. easements, dedication, land acquisition, etc.) ▪ Indicate the interim measures required for erosion, pond siltation and sedimentation, downstream works, riparian flow considerations, during the construction phase. ▪ Indicate if other agencies are required to grant approvals or issue permits. ▪ Submit plans and calculations to support the proposals. The report includes the following information: 1. Location map of the subject property 2. Property description 3. Present owner contact 4. An external drainage plan including all upstream lands and any diversion of drainage routes 5. An internal drainage plan including flood and fill lines and overland flow routes 6. Schematic layout of existing and proposed sanitary and storm sewer networks 7. Schematic layout of the subwatershed showing the main watercourse, tributaries and trunk sewers 8. Any supporting calculations and drawings, such as: ▪ Calculation of surface run-off ▪ Calculation of permissible release rate and required on site storage ▪ Methods of run-off attenuation and on site storage ▪ Measures to maintain or improve water quality ▪ Measures to minimize impact of run-off downstream including erosion, flooding etc. The Final Report must include detailed analyses (computer modeling results and calculations) and design of the major and minor systems and proposed stormwater management facilities based on the proposed design concepts and parameters accepted in the Preliminary Report. Refer to interim guidelines for specific requirements that are currently applied in each service district.

Comments	The level of detail for the Stormwater Management Report depends on the type of application, the size of the development and the types of stormwater management schemes proposed. For example, a report for a Plan of Subdivision will typically be more complex than a report in support of a Site Plan Control application.

GRCA FINAL SWM SUBMISSION CHECKLIST

This checklist is intended for use by the Consultant to ensure that all components of a Final SWM submission are included in an effort towards minimizing the time requirements of the revie and approval process. Along with the Preconsultation Checklist and Preliminary SWM Checklist, it will serve as a quick reference to review staff that all required supporting infomation has been provided. This checklist should be included with the Final SWM submission. The checklist was created in conjunction with the Homebuilders Association/GRCA Liaison Committee and will be updated periodically, with the current version available for download from the GRCA website (www.grandriver.ca).

Project Name	ID #		
Main Report			
Background Report(s) Summary	Yes	No	N/A
SWM Objectives / Criteria Summary	Yes	No	N/A
Description of Existing Conditions incl. Topography, Surface Drainage (with Externals), Soils, GW Characteristics	Yes	No	N/A
Infiltration - Requirements, Proposed Strategy, Results	Yes	No	N/A
Water Quality - Requirements, Proposed Strategy, Results	Yes	No	N/A
Erosion Protection for Receivers - Requirements, Proposed Strategy, Results	Yes	No	N/A
Water Quantity - Requirements, Proposed Strategy, Results	Yes	No	N/A
Summary of Monitoring Programs completed, on-going, or anticipated	Yes	No	N/A
Erosion Potential Evaluation and Anticipated Control Strategy	Yes	No	N/A
Reports / Plans signed and sealed	Yes	No	N/A
Figures / Plans			
Location Plan	Yes	No	N/A
Pre-Development Storm Drainage Boundaries - include existing topographic information	Yes	No	N/A
Post-Development Storm Drainage Boundaries - include proposed grading information	Yes	No	N/A
Schematic Representations of Pre- and Post-Development Hydrologic Models	Yes	No	N/A
Plans and Profiles for SWMF's and Outlet Configurations	Yes	No	N/A
Grading Plan(s) - should include delineation of Constraint Areas and associated Buffers	Yes	No	N/A
Cut/Fill Plan(s) - required primarily in floodplain areas or where GW table may be an issue	Yes	No	N/A
GW Elevations Plan - relative to proposed grades (required primarily in areas where GW table may be an issue)	Yes	No	N/A
SWMF Landscape Plan(s)	Yes	No	N/A
Erosion and Sediment Control Plan(s)	Yes	No	N/A
Appendices			
Pre-Consultation Checklist	Yes	No	N/A
Hydrologic Modeling Input Parameters with Supporting Justification (calcs and/or references)	Yes	No	N/A
Stage-Storage-Discharge Table for SWMF (include sample equations and outlet characteristics)	Yes	No	N/A
Sediment Forebay Sizing Calculations (including Settling / Dispersion Lengths and Cleanout Frequency requirements)	Yes	No	N/A
Sizing analysis for all other components of the SWM system - conveyance, stability, etc.			
Pre-Development Hydrologic Analysis	Yes	No	N/A
Post-Development Hydrologic Analysis	Yes	No	N/A
Pre-Development Hydraulic Analysis	Yes	No	N/A
Post-Development Hydraulic Analysis	Yes	No	N/A
Water Balance Analysis	Yes	No	N/A
Geotech./Hydrogeo. Report & Plan(s) (may be same as at Preliinary design) - incl. GW contour mapping where GW table may be an is	Yes	No	N/A

Additional Items and/or Clarification Notes (attach additional information as required)

Consultant Team Contact Info:	Landowner Contact Info:	Checklist Prepared by::
	GRCA Contact Info:	Date:

GRCA PRELIMINARY SWM SUBMISSION CHECKLIST

This checklist is intended for use by the Consultant to ensure that all components of a Preliminary SWM submission are included in an effort towards minimizing the time requirements of the review and approval process. Along with the Preconsultation Checklist, this checklist will also serve as a quick reference to GRCA staff that all supporting infomation has been provided, prior to proceeding with a circulation and/or review. It is recognized that the PSWM submission is typically submitted as a component in the Draft Plan Approval process. The user should note that this checklist covers only the SWM aspects of an overall submission and that items such as the Draft Plan itself and any other supporting environmental documentation may also be required. This checklist should be included with the Preliminary SWM submission. The checklist was created in conjunction with the Homebuilders Association/GRCA Liaison Committee and will be updated periodically, with the current version available for download from the GRCA website (www.grandriver.ca).

Project Name	ID #		
Main Report			
Summary Listing of Background Report(s)	Yes	No	N/A
SWM Objectives / Criteria Summary	Yes	No	N/A
Description of Existing Conditions incl. Topography, Surface Drainage (with Externals), Soils, GW Characteristics	Yes	No	N/A
Infiltration - Requirements, Proposed Strategy, Preliminary Results	Yes	No	N/A
Water Quality - Requirements, Proposed Strategy, Preliminary Results	Yes	No	N/A
Erosion Protection for Receivers - Requirements, Proposed Strategy, Prelimnary Results	Yes	No	N/A
Water Quantity - Requirements, Proposed Strategy, Preliminary Results	Yes	No	N/A
Summary of Monitoring Programs completed, on-going, or anticipated	Yes	No	N/A
Erosion Potential Evaluation and Preliminary Control Strategy	Yes	No	N/A
Reports / Plans signed and sealed	Yes	No	N/A
Figures / Plans			
Location Plan	Yes	No	N/A
Pre-Development Storm Drainage Boundaries - include existing topographic information	Yes	No	N/A
Post-Development Storm Drainage Boundaries - include preliminary drainage / grading information	Yes	No	N/A
Schematic Representations of Pre- and Post-Development Hydrologic Models	Yes	No	N/A
Preliminary Plans of SWMF's and Outlet Configurations (Plan and Profile)	Yes	No	N/A
Preliminary Grading Plan(s) - should include delineation of Constraint Areas and associated Buffers	Yes	No	N/A
GW Elevations Plan - relative to preliminary grades (required primarily in areas where GW table may be an issue)	Yes	No	N/A
Appendices			
Pre-Consultation Checklist	Yes	No	N/A
Hydrologic Modeling Input Parameters with Supporting Justification (calcs and/or references)	Yes	No	N/A
Stage-Storage-Discharge Table for SWMF (include sample equations and outlet characteristics)	Yes	No	N/A
Sediment Forebay Sizing Calculations (incl. % of perm. pool area, settling/dispersion lengths, velocity, cleanout frequency requirements)	Yes	No	N/A
Pre-Development Hydrologic Analysis	Yes	No	N/A
Post-Development Hydrologic Analysis	Yes	No	N/A
Pre-Development Hydraulic Analysis	Yes	No	N/A
Post-Development Hydraulic Analysis	Yes	No	N/A
Water Balance Analysis (Sizing of Infiltration Trenches / Galleries)	Yes	No	N/A
Geotechnical / Hydrogeological Report & Plan(s) - include GW contour mapping where GW table may be an issue	Yes	No	N/A

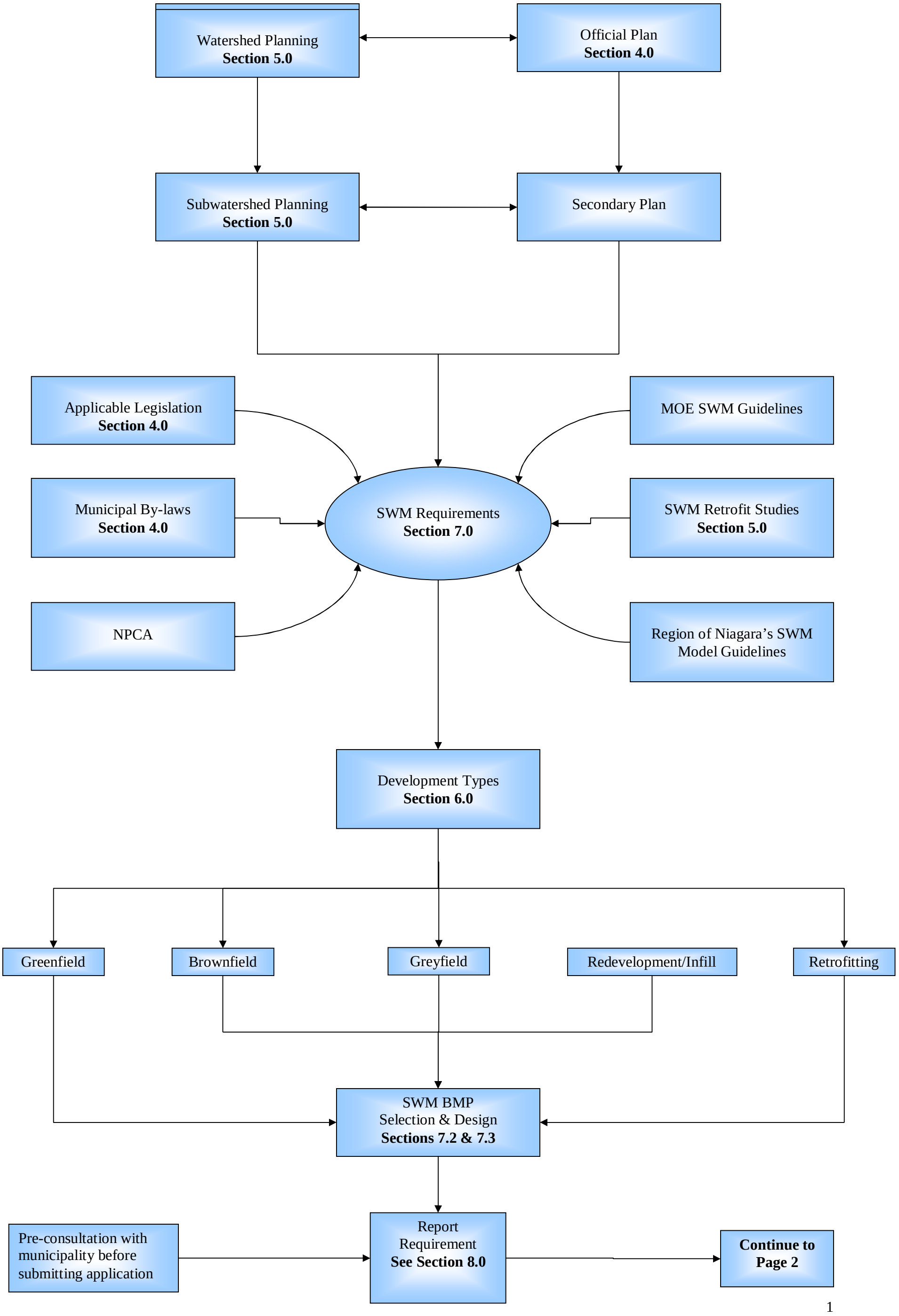
Additional Items and/or Clarification Notes (attach additional information as required)

Consultant Team Contact Info:	Landowner Contact Info:	Checklist Prepared by::
	GRCA Contact Info:	Date:

APPENDIX L
Stormwater Management Planning Flow Chart/Decision Tree

DRAFT NPCA SWM POLICIES FLOW CHART

Overview of Stormwater Management Planning



DRAFT NPCA SWM POLICIES FLOW CHART

Approval Process
Section 9.0

Development Application

Municipality
Public Works
Circulate to ensure conformity with urban design guidelines, landscaping, parking and lot grading/drainage and stormwater management
Circulate to outside agencies
(**Refer to page 5 for typical department review)**

Redevelopment & Infill exempt from site plan control
Got to Page 3.0

Regional Roads

Ministry of the Environment Approval Required?

Does the site fall within the Niagara Escarpment Commission (NEC) development control area?
Will require a permit from the NEC before the building permit can be issued.

NPCA Pre-screening for Municipal Plan Review

Region of Niagara
Region of Niagara Public Works Department
Region of Niagara Planning & Development Department
Note: NPCA has a memorandum of understanding with Region to review SWM submissions

Niagara Escarpment Commission

DFO ↔ NPCA

Ministry of the Environment

Development Agreement (i.e. site plan agreement, subdivision agreement)

Issue Permit, Authorization

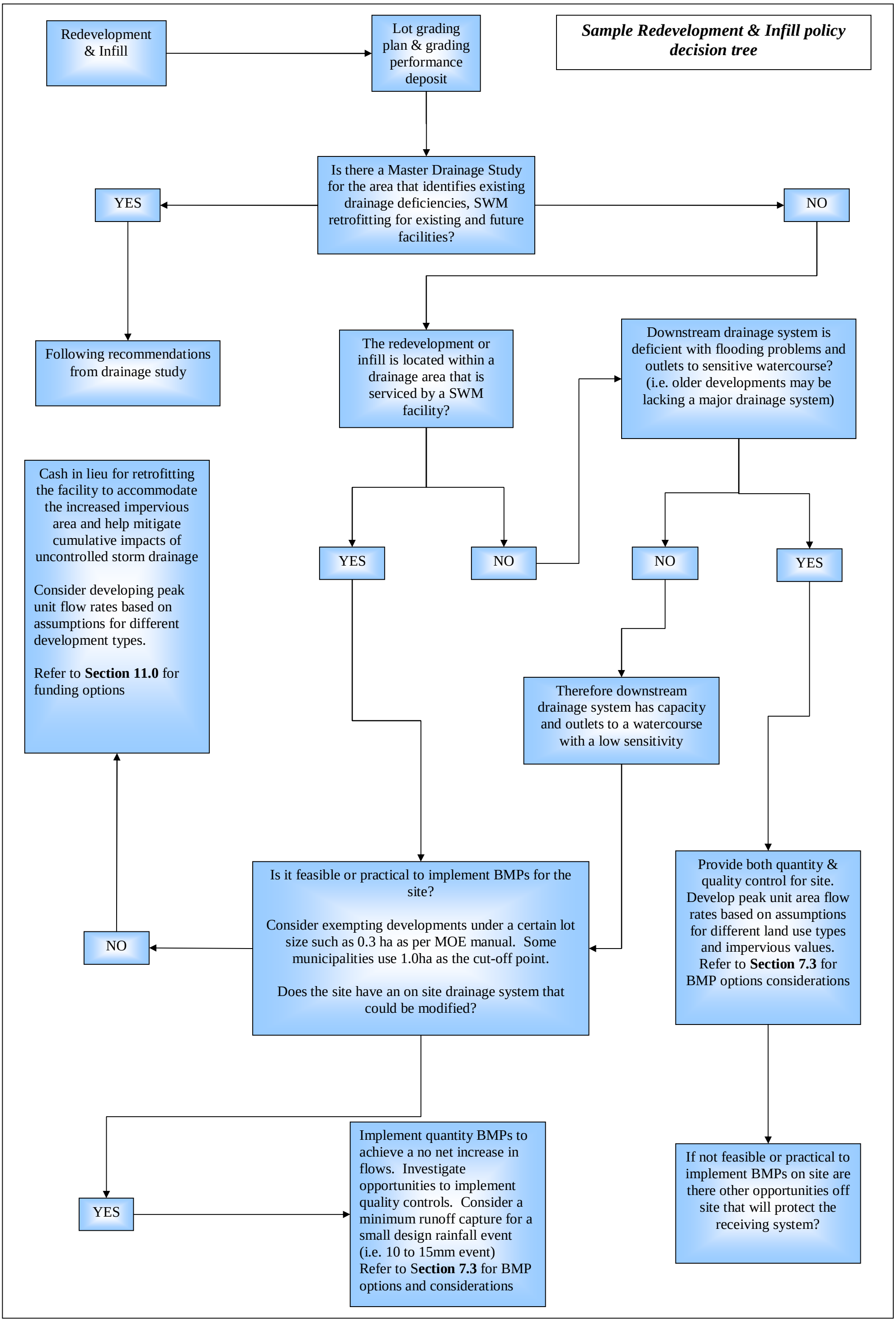
APPROVAL "CofA"

NPCA Approval

Building Permit

Go to Page 4

DRAFT NPCA SWM POLICIES FLOW CHART



DRAFT NPCA SWM POLICIES FLOW CHART

Construction

Site Alteration, Grading, Construction & Monitoring **Section 10.0**

Implement Sediment & Erosion Control BMP's Prior to Construction & Site Alteration

Developer to Prepare Erosion & Sediment Erosion Control Reports for Inspection & Monitoring **Section 10.2**

According to Current Sediment & Erosion Control Guidelines **Section 7.5**

During construction and after construction monitoring until site has stabilized.

Submit to Municipality & NPCA

Maintenance Period Begins

Start Post Construction Monitoring

Input to Database Trigger Inspections

Maintenance Period Ends Does it meet targets?

NO

Make necessary adjustments

Feedback to Engineering Review to report what is and isn't working

YES

Post Assumption Monitoring & Maintenance

Assume SWM Facility

Monitoring & Maintenance **(Section 10)**

Set up monitoring locations throughout the watershed
Water quality
Water quantity
Aquatic habitat

Grab Samples & Instantaneous Readings

Continuous Sampling
- Depth Loggers
- Flow Loggers
- Automated Samplers
- Temperature Loggers

Regular Inspections

Perform Maintenance Work

NO

Facility Operating as per CofA?

YES

Repair Inlet/Outlet Structures

Sediment Removal

Wetland Plant Harvesting

Re-vegetate & Repair Erosion

DRAFT NPCA SWM POLICIES FLOW CHART

Typical Communication Structure within Municipality
(Not including outside agency review)

Application submitted

Parks and Recreation /Leisure
Approval is required for any works on park lands, tree preservation plan approvals, landscaping

Planning

Check conformity to OP, aesthetics, urban design, etc.

Public Works Department
- Responsible for construction inspection
- **Subdivision Construction Monitoring -** sediment and erosion control (mud matts, dust control, etc.)
- Should receive reports from developer on a bi-weekly basis
- Monthly basis after construction activities have been completed and as the site stabilizes

Building Department
Ensures that a lot grading, drainage, servicing site plan is provided for review
Application will have the necessary triggers to forward to outside review agencies
Comment on Ontario Building Code

Engineering
- Approval of subdivision engineering drawings
- Subdivisions agreement preparation
- Site plan review and approval
- Approvals of SWM reports & design
- Approval of grading and drainage for all building permits
- Approval of site alteration permits
- Comment on draft plan of subdivision and/or condominium
- **Monitoring sediment and erosion control**
- Clear agreement conditions and review lot grading
- Process the SWM assumption request & final SWM facility inspection
- Review as-built SWM

Approve Building permit when all engineering issues have been addressed

Forward agreements to Clerk's Department for council to approve

Legal Service
Draft agreements

APPENDIX M
Sample Sediment and Erosion Control Plan

APPENDIX M

DEVELOPING AN EROSION AND SEDIMENT CONTROL PLAN FOR LAND DEVELOPMENT

1.0 INTRODUCTION AND BACKGROUND

Soil erosion by water is an ancient and natural process. However, human activities such as land development or construction projects can accelerate erosion rates to unacceptable levels and cause unwanted sedimentation. With respect to land development projects, one must always be cognizant of native erosion rates for a particular site or region (Li, 1997). Without this reference state information, it is difficult to determine the extent of human impact upon a site. Therefore, it is important that a site be monitored prior to development in order to compile reference conditions for future comparison.

Soil erosion by definition involves two important chronological events: a) the *detachment of particles* and b) their *subsequent transportation* (Cooke and Doornkamp, 1990). The two chief agents for this work are *raindrops* and *flowing water*. Raindrop (or rainsplash) erosion involves the detachment of particles from soil clods by impact and their movement by splashing (Cooke and Doornkamp, 1990). On the other hand, runoff erosion is the transportation of loose material by water flowing as sheet flow, or as concentrated flow in rills or gullies (Cooke and Doornkamp, 1990). The nature of soil erosion by water is dependent upon the relationship between the *erosivity* of raindrops and running water, and on the *erodibility* of the soil material (Cooke and Doornkamp, 1990).

This document is organized into four main sections after this introductory section. The first, *Concern and Impacts*, examines at two types of damage that can be attributed to accelerated soil erosion and sedimentation. The second, *Designing a Solution,* will look at how an Erosion and Sediment Control (ESC) plan should be developed. Thirdly, *Appendix L* of this Appendices package will show examples of erosion and sediment control checklists. Finally, the last section of this document will show an example of a complete Erosion and Sediment Control Plan.

2.0 CONCERNS AND IMPACTS

In general, there are two main types of damage that accelerated soil erosion and related sedimentation can cause. This list is modified from Li, 1997.

1. <u>On-site damages</u> – these damages, of the soil erosion and within the construction site boundary. They include:
2.
   - Undermining and loss of structures;
   - Loss of topsoil;
   - Loss of parkland;
   - Degradation of ravines and loss of valuable open space;
   - Loss of fertile soil and mature vegetation;
   - Washing out of lanes and roads; and
   - Clogging of drainage systems such as catch basins, sewers, and ditches.

2. <u>Off-site damages</u> – these damages, which result from eroded soil being transported as sediment and subsequently deposited downstream outside the construction site, and

include:

- Impairment of water quality and drinking and industrial water supplies;
- Deposition of unsightly and otherwise damaging sediment deposits on useful and productive land surfaces;
- Clogging of receiving channels and sewers which may result in reductions in waterway capacity, increase flooding, interference with navigation, and excessive channel erosion;
- Silting of downstream flood control reservoirs and other water impoundments;
- Increased turbidity in stream channels which may impede the passage of light through the water and diminish biological activity and may render waters generally less attractive to swimmers, boaters, and anglers; and
- Deposition of sediment in critical fish-spawning areas which may diminish or destroy fish populations.

3.0 DESIGNING A SOLUTION: DEVELOPING AN EFFECTIVE EROSION AND SEDIMENT CONTROL PLAN

3.1 Questions and Answers (Li, 1997)

What is an Erosion and Sediment Control (ESC) Plan?

An ESC plan is a document which describes the potential for erosion and sedimentation problems on a construction site. This plan will have both a written (qualitative) portion which is descriptive in nature, and visual component usually consisting of maps or site plans. An ESC Plan is required for all new development and redevelopment.

What is required for an acceptable ESC Plan?

An adequate plan must contain enough information to satisfy the approval agencies that problems of erosion and sediment have been adequately addressed for the proposed project. The level of planning and detail will be dependent on factors such as size of the parcel, slope of the terrain, and proximity to streams or sensitive areas.

Why Comprehensive Site Planning?

ESC planning should be an integral part of the site planning process. The necessity for costly erosion control measures can be minimized if the site can be adapted to existing conditions and good conservation principles are applied. Planning at this stage may identify opportunities for conversion of temporary erosion control devices into permanent facilities.

Who is responsible for Preparing an ESC Plan?

The owner of the land being developed has the responsibility for plan preparation and submission. The owner may designate someone (i.e. a Professional Engineer, architects, contractors, etc.) to prepare the plan, but he or she retains the ultimate responsibility.

3.2. Seven Basic Principles for Erosion and Sediment Control (Li, 1997)

1. Plan the development to fit the site.

a) Plan the development to take advantage of existing topography, soils, drainage patterns, and natural vegetation.

b) Determine where runoff will enter, cross, and exit the site (i.e. site drainage analysis).

c) Determine whether subsurface water is a factor; avoid construction if possible in these areas.

d) Locate large graded areas on the most level portion of the site.

e) Keep development out of the floodplain, where possible.

f) Avoid steep slopes, exposure of erodible soils and use of soils unsuitable for the intended purpose, where possible.

g) Break up long steep slopes with benching, terracing, or through construction of diversion structures (may require geotechnical investigation).

2. Minimize the extent of the disturbed area and duration of exposure.

a) Select source erosion control practices, as prevention of pollutant release is superior to pollutant capture later.

b) Limit and phase clearing of vegetation as existing vegetation is the most effective erosion control measure.

c) Plan the development phases so that only areas being actively developed are exposed at one time; cover all other areas with a temporary or permanent cover.

d) Complete grading as soon as possible; protect the area as soon as possible after the completion of grading by implementing permanent vegetation cover.

e) Revegetate cut and fill slopes as work is progressing (i.e. stages seeding).

3. Stabilize and protect disturbed areas as soon as possible.

a) Stabilize disturbed areas immediately after final grading, using mechanical or vegetative measures, or a combination of the two.

4. Keep runoff velocities low.

a) It is important to understand that two factors will increase runoff velocities and volume during construction:

i) Removal of existing vegetation
ii) Increasing the amount of paved (impervious) area on the site.

Measures must be taken to counteract these anticipated increases in runoff volume and velocity.

b) Minimize slope length and steepness

5. Protect disturbed areas from runoff.

   a) Direct runoff away from bare soil areas.

6. Retain sediment within the corridor or site area.

7. Implement a thorough maintenance and follow-up program.

3.3. Procedure for Producing an ESC Plan (Li, 1997)

Step 1: Data Collection

1. Topography: prepare a small scale topographic map showing the existing contour elevations at intervals of 0.5 to 1 metres.

2. Drainage: locate all existing drainage swales and patterns on the topographic map, including all existing underground storm drain pipes.

3. Soils: determine all major soil types and display on the topographic map either directly or using an overlay (use Geographic Information System)

4. Ground cover: mark features such as tree clusters, grassy areas, and rare or sensitive vegetation on the map. Existing large trees above a specified diameter may be located at this point. Local requirements for tree preservation should be determined. Areas of exposed soils should be identified as well.

5. Adjacent areas: areas adjacent to the site should be investigated and features such as steams, roads, lakes, wetlands, and wooded areas marked. These areas should be identified because of the potential for off-site damage.

6. Existing development: mark any existing buildings or facilities on the site or adjacent to the site.

7. On and off-site utilities: identify all utility corridors, roadways, clearing limits, for all on-site and off-site utility construction.

Step 2: Data Analysis

1. Topography: the longer and steeper the slope, the greater the erosion potential.

   0-7% slope: Low erosion hazard
   7-15% slope: Moderate erosion hazard
   >15% slope: High erosion hazard

Excessively long slopes will be prone to erosion hazards:

0-7% slope – 300 feet
7-15% slope – 150 feet
>15% slope – 75 feet

These distances may be shorter in areas with highly erodible soils.

2. Natural drainage: identify natural drainage such as overland flow, swales, depressions and natural watercourses. It is in these areas where water will tend to concentrate.

Where possible, natural channels to drain water, rather than constructing man-Man channels should be used. Man-made ditches and waterways can become part of the erosion problem if not properly stabilized.

Identify need for stormwater retention and/or detention areas. Establish sites for retention/detention areas.

Check the site for saturated soil or areas where groundwater may be encountered during construction. Avoid construction in these areas where possible

3. Soils: determine the following site characteristics:

a) flood hazard
b) depth to bedrock
c) depth to season water table
d) permeability
e) shrink-swell potential
f) texture
g) erodibility

4. Ground cover: ground cover is the *most important* factor in preventing erosion. Existing vegetation should be saved where possible. If it is necessary to remove vegetation, use measures such as staging construction, mulching, or temporary seeding to stabilize the area.

Staging construction means stabilizing one part of the site before disturbing another.

Buffers around water bodies should be delineated and the clearing limits flagged.

Step 3: Site Plan Development

After the analysis of site limitations, the planner develops the site plan. Buildings, roads, and parking lots should exploit strengths and overcome the limitations of the site.

1. Fit development to the existing terrain. Avoid unnecessary land disturbance.

2. Confine construction activities to the least critical areas. Protect erodible areas.

3. Cluster buildings together. The cluster concept lessens the erodible area, reduces runoff, and generally reduces development costs.

4. Minimize impervious areas. Keep paved roads and parking lots to a minimum.

5. Use natural drainage system. Preserving the natural drainage system instead of replacing it with storm drains or concrete channels.

Step 4: Plan for Erosion and Sediment Control

Once the layout of the site has been decided upon, a plan to control erosion and sediment must be created.

1. Determine the limits of clearing and grading:
Decide exactly which areas must be disturbed to accommodate the proposed construction. Show all limits of clearance for flagging in the field.

2. Divide the site into drainage areas by considering each area separately:
Determine how erosion and sedimentation can be controlled in each small drainage area before looking at the entire site.

NOTE: It is typically easier to control erosion at the start of construction than to contend with sediment after it has been carried downstream.

3. Select erosion and sediment control practices, emphasizing source control and vegetation practices:
Vegetative ground cover should be considered a priority. Structural measures should be considered only after cover practices are used to the maximum extend possible. Good management practices are also important, since they can reduce the need for structural controls. Management practices such as proper operations and maintenance are necessary for successful implementation of structure controls.

a) Cover Practices:

Keep in mind that the first line of defence is to prevent erosion. That is accomplished by protecting the soil surface from rainfall impact and using source controls. The best way to protect soil is to preserve the existing ground cover.

Erosion and sediment control plans must contain provisions for permanent stabilization of disturbed areas. The selection of permanent vegetation should be based on:

- Establishment requirements
- Adaptability to site conditions
- Aesthetics
- Maintenance requirements

b) Structural Practices:

Structural practices are generally more expensive and less effective than source controls. They are often used in series with other vegetative or structural practices to capture sediment, as a second line of defence.

c) Management Measures:

i) Sequence construction.

ii) Temporary seeding immediately after grading.

iii) When possible, avoid grading activities from November through to March.

iv) Stage the construction on large projects.

v) Develop and carry out a regular maintenance schedule for erosion and sediment control practices.

vi) Physically mark off limits of land disturbances on sites with tape, signs or other methods so that workers can see areas to be protected.

vii) Make sure that all workers are educated on major provisions of the erosion and sediment control plan.

vii) Designate responsibility for implementing the erosion and sediment control plan to one individual, preferably the construction superintendent or foreman.

Step 5: Control of Pollutants Other than Sediment

These measures may be directed toward control of nutrients and pesticides to disposal of solid or hazardous wastes.

Step 6: Plan Preparation

The plan is prepared based on the information which has been gathered from Steps 1 through 5. The plan consists of two parts: a descriptive section and a site plan or map. The descriptive section describes the problems and solutions with justification. The site plan is a series of maps or drawings which illustrate the application of the solutions on the site.

REFERENCES

Cooke, R.U., and Doornkamp, J.C. (1990). Geomorphology in Environmental Management: A New Introduction, 2nd Ed. New York: Oxford University Press. p. 80.

GTACA (Greater Toronto Area Conservation Authorities). (2006). Erosion and Sediment Control Guideline for Urban Construction. Prepared December 2006. p. APPENDIX F.

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Sample Erosion and Sediment Control Plan (Li, 1997)

3.10 Case Study 2[1]

This design case study is a composite of several subdivisions recently developed in the Region of Hamilton-Wentworth. The various segments of drawings have been assembled to illustrate a variety of erosion and. sediment control measures (Fig. 3.7).

The subdivision is to be constructed in two phases and has a total area of 4.4 hectares. The first phase of the development is located adjacent to a creek and involves a slope. The second phase involves a parcel of table land some distance from the creek.

The applicable standards for erosion and sediment control measures are documented in "Keeping Soil on Construction Sites: Erosion and Sediment Control Guidelines for Hamilton Harbour Watershed and Region of Hamilton-Wentworth" which s available from the Hamilton Region Conservation Authority.

Step 1: Background data collection

1. Topography
   The first phase of the development slopes south to the creek with average slope of 10%. The north limits of the phase consist of an eroding slope 5 metres high which is to be regraded to 3H: 1V stable angle. The second phase slopes in a north westerly direction with an average slope of 3%.

2. Drainage
   In the first phase, drainage is by overland flow directly to the creek. In the second phase, overland flow drains to an existing road (Spencer Creek Drive) and then southward to the creek.

3. Soils
   The first phase of the development consists of silty foam and is considered highly erodible. The second phase has soil of moderate erodibiiity consisting of sandy loam.

4. Ground Cover
   The first phase has dense riparian vegetation and trees along the south limits covering an area of about 10 metres wide adjacent to the creek. The remainder of the property is sparsely vegetated with no significant species.

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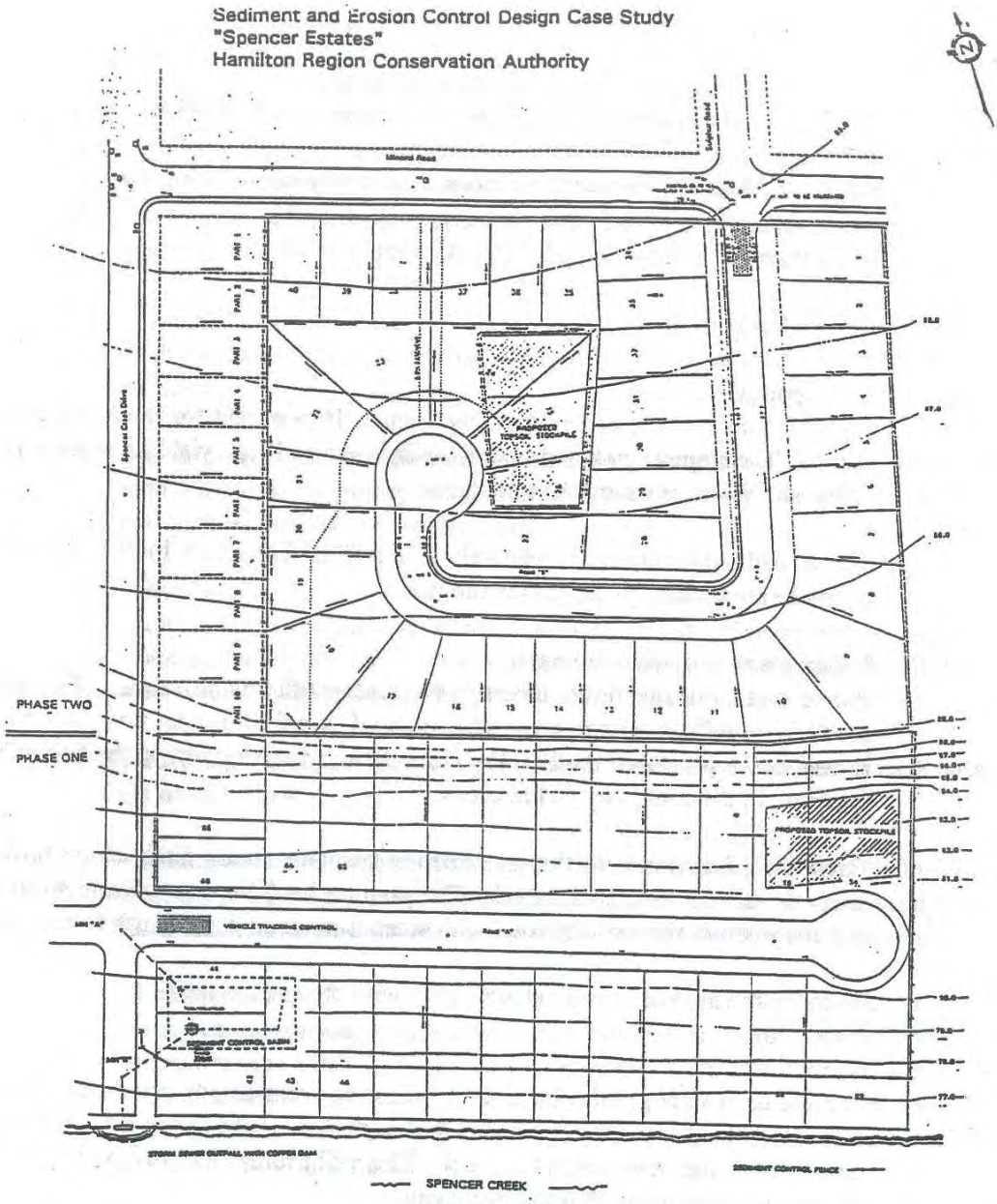
[1]This case study was contributed by Hamilton Region Conservation Authority.



Erosion and sediment control Case Study 2

Figure 3.7

5. Existing land use on property and adjacent areas
The proposed development area consists of open space rural lands. The south limit consists of a warm water creek with a floodplain which extends 7 metres onto the property. Areas to the north and west consist of existing subdivisions. The area to the east consists of open space rural land. A bridge across the creek is proposed at some time in the future and dictates the road pattern.

Step 2: Data Analysis

1. Topography and soils
The first phase slopes are moderately steep at 10% except for the north limit which is 33%. The slopes combined with the silty loam soil type yield an erosion potential of the site which is estimated to be high.

The second phase slopes are relatively mild at 3%. The sandy loam soils yield a low to moderate erosion potential for the site.

2. Existing and proposed drainage.
Phase one drainage flows directly overland south to the creek. The proposed subdivision will use storm sewers to convey flows from the lot nos. 54 through 66, as well as the proposed road, to the creek. The remaining lots in the first phase will continue to drain directly to the creek.

Phase two drains in a northwest direction into an existing ditch which flows south along the existing road to the creek. The proposed subdivision will use storm sewers and reconstruct the existing road with storm sewers to drain south to the creek.

A single storm sewer headwall will be constructed at the creek.

3. Ground Cover
In order to provide positive lot drainage based on urban design standards and stabilize the existing slope, ground cover will be removed over the entire site except for a 15 metre wide buffer adjacent to the creek. This will protect the riparian vegetation and prevent encroachment into the floodplain.

Step 3: Site Plan and Erosion and Sediment Control

The site plan has been developed to stabilize the centrally located steep slope and avoid building on it or creating retaining walls. Also a buffer area adjacent to the creek has been maintained to avoid encroachment into the floodplain. The existing vegetation within the buffer area will aid in filtering sediment from overland runoff and pollutants long after the site is fully developed. The storm sewer system has been designed to outlet at one outfall to limit intrusion into the aquatic ecosystem for construction and future maintenance.

Steps 4 to 6: Erosion and Sediment Control Plan

1. General design, installation and maintenance requirements

All erosion and sediment control measures are to be installed prior to development and maintained throughout the construction process, until all disturbed areas are revegetated.

All erosion and sediment control measures are to be inspected and maintained after each rainfall to the satisfaction of the City Engineer and Hamilton Conservation Authority.

Any disturbed area not scheduled for further construction within 45 days be provided with a suitable temporary mulch and seed cover within 7 days of the completion of that particular phase of construction.

2. Scheduling

Sediment control fence is to be installed along the east property line and south grading limits of Phase One. Phase Two is to have sediment control fence installed along the west and north property limits.

Temporary vehicle tracking control stations are.to be established at each entrance to the development.

A sediment control basin is to be constructed occupying the area on lots 41,42 and 43 at the south west corner of Phase One. These lots are to be developed last and the basin maintained until the remainder of the lots are developed and stabilized.

The storm sewer from Manhole "A" (at the south west corner of Phase One adjacent to the vehicle tracking control) to the outfall will be bulkheaded to direct flow to a temporary pipe from this manhole to the north end of the sediment control basin to be constructed. A temporary pipe from the south end of the control basin to Manhole B will be constructed as the outlet. The outlet will be fitted with a perforated riser pipe to control outflow rate.

The sediment control basin requires a volume of 455 m^3 = 125 m^3 x 3.6 ha of contributing drainage area. The dimensions are to be 35 metres x 1 5 metres x 1.5 metres. The side slopes are to be 2H:1V. The slopes are to be seeded and mulched to prevent erosion. A plywood baffle 1.2 m high by 1 0 metres long is to be constructed in the basin bottom between the inlet and outlet to prevent 'short circuit" flows. A perforated riser pipe outlet structure is to be installed to release water from the pond at a rate of 0.5 m^3/s in order to settle out 90% of the soil particles 0.04 mm in diameter or greater. An emergency overflow spillway will be constructed and lined with rip-rap over the south end of the basin leading to the creek.

The Universal Soil Loss Equation (USLE) is defined as follows:

$A = 2.24\ (R)\ (K)\ (LS)\ (C)(P)^2$

where A is the soil loss per hectare per year;
2.24 is the imperial to metric conversion factor;
R,K,C,P from the MTO Drainage Manual
LS from Erosion and Sediment Control Handbook (Goldman et al., 1986)

The site is divided into similar topography and soil type to estimate the soil loss:

Phase One North Slope
Area = 0.255 ha, Soil = silt foam (1 % organic), Slope =33% @ 15 m
A= 2.24(100)(0.42)(6.67)(1)(.9) = 565 tonnes/ha/year
565 tonnes/ha/yr x 0.255 ha = 144 tonnes/yr = 54 m^3/yr

Phase One North Side of Road "A"
Area = 0.6 ha, Soil = silt loam (1 % organic), Slope = 10% @ 30 m
A= 2.24(100)(0.42)(1.37)(1)(.9) = 116 tonnes/ha/year
116 t/ha/yr x 0.6ha = 69.6 tonnes/yr = 26 m^3 /yr

Phase One Road "A"
Area = 0.44 ha, Soil = silt loam (1% organic), Slope = 3% @ 22 m
A= 2.24(100)(0.42)(0.26)(1)(.9) = 22 tonnes/ha/year
22 t/ha/yr x 0.44 ha = 9.7 tonnes/yr = 3.7 m^3 /yr

Phase One South Side of Road "A" (not including buffer)
Area = 0. 6 ha, Soil = silt loam (1 % organic), Slope = 10% @ 30 m
A= 2.24(100)(0.42)(1.37)(1)(.9) = 116 tonnes/ha/year
116 t/ha/yr x 0-6ha = 69.6 tonnes/yr = 26 m^3 /yr

Phase Two
Area= 2.55 ha, Soil= sandy loam (<.5% organic), Slope =3% @150m
A= 2.24(100)(0.27)(0.46)(1)(.9) = 25 tonnes/ha/year
25 t/ha/yr x 2.55ha = 63.8 tonnes/yr = 24 m^3/yr

Total annual soil loss from development = 133.7 m^3

Sediment removal must occur from the sediment control basin when its capacity is

[2]This version of the USLE can be found in the MTO Drainage Manual. The rainfall factor (R) in this equation is different from that shown in Table 3.1 and should be determined from Chart F4-1A of MTO Drainage Manual.

reduced by 50% (228 m^3). Therefore, based on the annual soil loss, sediment removal from the basin will be required about every 20 months.

Topsoil stockpiles will be established on lots 54 and 55 for Phase One and 24,25,26 for Phase Two and stabilized with seed.

Removal of vegetation and grading of the site may begin.

The exposed 3H:1V graded slope is to be stabilized using straw matting and seed.

Underground services are constructed.

Storm Outfall to creek is constructed using a coffer dam with dewatering to the sediment control basin.

Catchbasins and drop inlet structures protection measures are installed.

Construct houses and sod or seed and mulch lot as soon as possible.

Remove sediment control measures after disturbed areas are revegetated.

Flush all storm sewers of sediment.

Remove bulkhead at Manhole "A" and fill in sediment control basin to develop final three lots.

APPENDIX N
Sample Stormwater Management Pond Inspection Checklist

Sample Stormwater Operation and Maintenance Checklist (Knox County, 2006?)

INSPECTION CHECKLIST AND MAINTENANCE GUIDANCE (continued)
STORMWATER POND INSPECTION CHECKLIST

Location: _____ Owner Change since last inspection? Y N

Owner Name, Address, Phone: _____

Date: _____ Time: _____ Site conditions: _____

Inspection Items	Satisfactory (S) or Unsatisfactory (U)	Comments/Corrective Action
Embankment and Emergency Spillway		
Healthy vegetation?		
Erosion on embankment?		
Animal burrows in embankment?		
Cracking, sliding, bulging of dam?		
Blocked or malfunctioning drains?		
Leaks or seeps on embankment?		
Obstructions of spillway(s)?		
Erosion in/around emergency spillway?		
Other (describe)?		
Inlet/Outlet Structures and Channels		
Clear of debris and functional?		
Trash rack clear of debris and functional?		
Sediment accumulation?		
Condition of concrete/masonry?		
Metal pipes in good condition?		
Control valve operation?		
Pond drain valve operation?		
Outfall channels function, not eroding?		
Other (describe)?		
Sediment Forebays		
Evidence of sediment accumulation?		
Permanent Pool Areas (if applicable)		
Undesirable vegetation growth?		
Visible pollution?		
Shoreline erosion?		
Erosion at outfalls into pond?		
Headwalls and endwalls in good condition?		
Encroachment by other activities?		
Evidence of sediment accumulation?		
Dry Pond Areas (if applicable)		
Vegetation adequate?		
Undesirable vegetation growth?		
Excessive sedimentation?		
Hazards		
Have there been complaints from residents?		
Public hazards noted?		

If any of the above inspection items are **UNSATISFACTORY**, list corrective actions and the corresponding completion dates below:

Corrective Action Needed	Due Date

Inspector Signature: _____ Inspector Name (printed) _____

References

Knox County. (2006). Knox County Tennessee Stormwater Management Manual – Volume 2 (Technical Guidance). Available online: <http://knoxcounty.org/stormwater/pdfs/vol2/4-3-1%20Stormwater%20Ponds.pdf>

APPENDIX O
Sample Stormwater Management Standard Operating Procedures

APPENDIX O - STORMWATER MAINTENANCE MONITORING – STANDARD OPERATING PROCEDURES DEVELOPMENT

1. Introduction

Upon assumption of the stormwater facility, the owner is advised to produce a set of standard operating procedures (SOPs) that can be used to guide monitoring and maintenance of their newly acquired facility. Typically, procedures are set out for:

- Sediment Monitoring of Stormwater Management Facility
- Inspection Procedure for Stormwater Management Facility
- Water [Quality] Sampling of Stormwater Management Facilities and Streams

The following will outline some of the specific headings that should be included in a typical standard operating procedure, and also an example of a completed standard operation procedure.

2. Typical Structure of a Standard Operating Procedure (adapted from Town of Richmond Hill, 2006)

Heading	**Description**
Procedure Title:	Title of procedure
Procedure Number:	Identification number for tracking purposes
Procedure Type:	Type of Procedure to be performed i.e. monitoring
Description:	Purpose and description of the procedure
Staffing and Resources:	Supervisory authority, staff needed, equipment needed
Method:	Setup of procedure, how and when it will be conducted and by whom
Required Records:	Detail of what forms will be filled out and filed/saved to disc.
Environmental Implications:	Detail regarding significant or potential impacts that the procedure could have on the environment. Also includes mitigative solutions and consequences of not following the procedure.
References:	References used to write the standard operation procedure.
Changes/Revisions to Procedure	Record any changes to procedure from previous version.

3. Example of a Standard Operating Procedure (Town of Richmond Hill, 2006)

STANDARD OPERATING PROCEDURES

PROCEDURE TITLE: Sediment Monitoring of Stormwater Management Facilities

PROCEDURE #: SW-3

PROCEDURE TYPE: Operational Control, Monitoring and Measurement

1.0 DESCRIPTION:

The purpose of this procedure is to measure sediment accumulation and quality from stormwater management facilities (SWMFs) for use in evaluating whether facilities are meeting conditions of their Certificates of Approval and whether there are sediment quality concerns.

2.0 LEVEL OF SERVICE:

Sampling of SWMFs is a component of a monitoring program to ensure that performance of facilities remains in compliance.

3.0 STAFFING AND RESOURCES:

SUPERVISORY AUTHORITY:	Water Resources Coordinator
STAFF:	Water Resources Intern
	Other positions as determined by Supervisory Authority
CONTRACTED SERVICE:	Watershed Monitoring Consultant
EQUIPMENT:	35 meter measuring tape
	Wooden stakes
	Mallet
	Clamps (2)
	Sediment rod
	Small Zodiac boat
	Secchi disk
	Coring tube and 2 stoppers

Chest waders

Vehicle

4.0 METHOD:

4.1 Annual Program Set-up

a. The Supervisory Authority is responsible for setting up an annual program to measure sediment accumulation and quality in SWMFs for use in the performance evaluation of SWMFs in accordance with the *Performance Evaluation of Stormwater Management Facilities* Standard Operating Procedure.

b. The Supervisory Authority is responsible for setting up a monitoring program to measure sediment quality on an as needed basis.

c. SWMF monitoring sites to be monitored will be determined on an annual basis by the Supervisory Authority.

d. The Supervisory Authority will be responsible for assigning monitoring to Designated Staff or Contracted Services.

e. Sediment accumulation monitoring will be performed at each SWMF a minimum of every five years.

4.2 Sediment Accumulation

a. The Supervisory Authority is responsible for determining when a SWMF monitoring event will occur. Generally monitoring should not be scheduled when there has been significant rainfall in the previous 72 hours.

b. Consult with engineering drawing for the SWMF to be monitored to determine layout of transects.

c. Determine linear length of facility and divide length by 11 to determine distance between monitoring transects. Record location (length along facility) of each transect on the *Stormwater Management Facility Sediment Monitoring Form.*

d. Stake monitoring transects at waters edge. Number transect stakes from 1 to 10.

e. Record permanent pool elevation from staff gauge if present and record time on sediment monitoring form to allow for determination of actual elevation from monthly hydrograph.

f. Stretch and clamp measuring tape across Transect #1. Record length across transect on *Stormwater Management Facility Sediment Monitoring Form.*

g. Divide transect length by 10 to determine monitoring points and record locations (length across transect) on *Stormwater Management Facility Sediment Monitoring Form.*

h. At each monitoring point across transect record depth from water surface to sediment using the disk end of the sediment rod (or secchi disk if water is too deep) and record it on the *Stormwater Management Facility Sediment Monitoring Form.* Note: the sediment rod should be allowed to settle under its own weight for depth to sediment measurements.

i. At the center point of the transect (monitoring point 6) an additional measurement of depth from water surface to firm bottom should be made using the tapered end of the sediment rod. Note: The sediment rod should be forced down through sediment layer to a firm bottom for the depth to firm bottom measurement.

j. Repeat steps f. through i. for transects 2 – 10.

4.3 Sediment Quality

a. The Supervisory Authority is responsible for determining when a sediment quality samples will be taken.

b. The Supervisory Authority is responsible for assigning samples to be analyzed in house or at an accredited laboratory

c. At selected monitoring points, force the coring tube to firm bottom.

d. Firmly cork top end of the coring tube with a rubber stopper. Note: a good seal must be obtained at this point or the core will be lost during retrieval.
e. Keeping the coring tube vertical, pull the tube up and place rubber stopper in bottom of tube before withdrawing it from the water.
f. Measure depth of sediment in tube. Note and subtract the length of firm bottom material that may have been captured at the bottom of the core.
g. Record core location and sediment depth on *Stormwater Management Facility Sediment Monitoring Form.*
h. Retain core sample in glass sampling jar for subsequent analysis if required. The Supervisory Authority is responsible for assigning samples to be analyzed in house or sent to an accredited laboratory. Standard Operating Procedures exist for each in-house analysis.

5.0 REQUIRED RECORDS:

a. The following records shall be stored:
   i. Completed *Stormwater Management Facility Sediment Monitoring Form* - File as E07-[Individual Facility ID#]
   ii. Annual Watershed Monitoring program - File as E07-WSHED

6.0 ENVIRONMENTAL IMPLICATIONS:

6.1 Significant Environmental Aspects

a. Stormwater Discharge

6.2 Potential Environmental Impacts

a. Surface Water Contamination
b. Impacts on Biological Communities

6.3 Consequences of Not Following Procedure

This procedure is a component of a monitoring program to ensure stormwater management facilities are performing according to their approved design. Failure to follow these requirements will result in not being able to detect deficiencies in SWMF performance with environmental impacts listed in section 6.2 above and potential penalties under the Federal *Fisheries Act*, *Ontario Water Resources Act* and the *Environmental Protection Act*.

7.0 REFERENCES:

Performance Evaluation of Stormwater Management Facilities, Section B5 of the Standard Operating Procedures Manual

Stormwater Management Facility Sediment Monitoring Form, Section C4 of the Standard Operating Procedures Manual

8.0 CHANGES/REVISIONS TO PROCEDURE:

None

References

Town of Richmond Hill. (2006). Standard Operating Procedures Manual. Prepared by Water Resources Coordinator, Town of Richmond Hill Engineering and Public Works Department, 19 April 2006.

APPENDIX P
Detailed Review of Official Plan Policies

APPENDIX P – REVIEW OF OFFICIAL PLANS RELATING TO STORMWATER MANAGEMENT

1.0 INTRODUCTION

1.1 Review of Current Practices

A questionnaire was circulated to all municipalities within the Niagara Region and the NPCA watersheds as part of the first step in identifying current SWM practices. A sample questionnaire and summary of results can be found at the end of this section.

The questionnaire results indicate that there is a wide variation within the municipalities as to whether current policies and formal guidelines are in place. They all follow current MOE *Stormwater Management Guidelines* (2003) for general direction while some have developed guidelines more specific to their area. SWM targets have been developed in some areas, primarily based upon subwatershed strategies.

Technical design guidelines do not exist in all areas and some are being developed. The majority of the municipalities agree that there is a need for uniform SWM guidelines, but with allowance for specific site conditions. Not all municipalities have a formalized SWM maintenance program but see the need to have a consistent approach. Municipalities were also requested to forward copies of applicable and relevant guidelines for review in this study.

SWM design standards and/or policies were obtained for seven of the municipalities. Other drainage policies and by-laws relating to SWM were also downloaded from websites where available. **Appendix B** summarizes all SWM policies, standards, and by-laws that were used to compare SWM practices for locales within and outside the Niagara Region and the NPCA watersheds.

The literature review process undertaken is outlined below:

- Compare Practices in Other Jurisdictions and SWM Policy Trends – This review exercise helped to identify policy gaps and recommend policies that would benefit the municipalities within the Niagara Region and the NPCA watersheds. OPs, SWM policies and design standards were reviewed for other municipalities outside the study area to:
  - Observe current trends and advances; and
  - Identify policies and by-laws currently in use that would benefit municipalities within the study area;
- Identify SWM Policy Needs and Opportunities for Policy Improvements – Recommendations were made as to what policies would be appropriate for all municipalities region wide;
- Identify and Compare Alternatives for Changes to SWM Policies and Procedures – Policy options were proposed that worked off the strength of policies and procedures within the Niagara Region and the NPCA watersheds, and strengthening or enhancing with policies and procedures from the area; and
- Develop a recommended approach for SWM policies and procedures – The final step was to review with the committee policy and procedure options that would be implemented across the Niagara Region and the NPCA watersheds.

Appendix C provides the table that was used to compare SWM design standards and policies for municipalities within the Niagara Region and the NPCA watersheds.

The OPs available for each municipality were summarized in a table in order to make direct comparisons of policies relating both directly and indirectly to SWM. The table is located in **Appendix D.** Several

municipalities within the study area have recently updated or are in the process of updating their OPs. Updated OPs, where available, were reviewed in preparation of this draft document.

As illustrated in **Figure 3.0,** committee meetings were required throughout the entire process to receive input and direction. **Appendix E** provides copies of the meeting minutes.

1.2 Watershed and Subwatershed Planning

The majority of the OPs reviewed provide specific policies that show clear direction on watershed and subwatershed planning (see **Section 5.0** for more details). The following provides some example policies contained in the OPs that were reviewed:

- Undertake watershed and subwatershed planning in areas of urban development pressure and areas where significant environmental concerns have been identified. Work with the CAs, provincial government, neighbouring municipalities, and the county to establish and achieve water quality and quantity objectives;
- Recommends the ecosystem approach for environmental planning, such as watershed studies, to guide development and conservation at a broad level. Provide general requirements for watershed studies;
- Town shall participate with the Niagara Region and NPCA to complete watershed studies and provide some key components of a subwatershed plan;
- Where a major land use change or plan is proposed that goes beyond an individual site specific development proposal such as a 'Community or Neighbourhood Level' an Environmental Planning Study will be required;
- Shall work cooperatively with the CAs, stakeholders and other agencies to prepare and implement watershed plans; and
- Subwatershed Study TOR to be developed in consultation with the CA and OP outlines what should be included in the subwatershed plan. Once endorsed by Council, the city must implement the recommendations wherever possible through amendments to the OP, Secondary Plans, and zoning by-law amendments. Conditions of approval for new developments, environmental assessments of servicing and infrastructure plans, habitat restoration, and landowner stewardship. See **Appendix R** for a sample Subwatershed Study TOR.

1.2.1 Trends and Advances

Policies in Niagara Region are consistent with what other municipalities are doing. The City of London states in their SWM policies that subwatershed plans are to be prepared and adopted by council. The City of Kelowna, British Columbia recommends in their OP updating drainage basin plans and costs, as required, to reflect development trends, transportation network construction, and impacts related to stormwater.

1.3 Secondary Plans/Neighbourhood Plans/Urban Renewal Plans

OPs were reviewed for policies related to Secondary Plans and Neighbourhood Plans. Secondary Plans and Neighbourhood Plans are prepared for specific areas of the municipality to provide a basis for more detailed planning.

The following is a summary of some of the policies observed in the OPs:

- Development of neighbourhoods are planned through preparation of Secondary Plans;
- Policies provide details as to what Secondary Plans should include and specific goals such as Secondary Planning policies should have flexibility to adapt to new development trends,

- All applications for development shall conform to the recommendations in a Secondary Plan as it pertains to the subwatershed plan;
- The secondary plans shall follow the policy direction of the OP but provide more detail on such things as land use densities and design requirements for compact urban form and redevelopment;
- The plans are adopted as amendments to the OP;
- The municipality prepares the TOR as to what the Secondary Plans should include;
- Secondary Plans should be supported with environmental planning studies;
- Secondary Plans are not required for individual site specific development proposals;
- Secondary Plans shall indicate how the goals and policies of the OP are to be implemented prior to development proceeding; and
- Prior to the approval of any new development, comprehensive Secondary Plans will be required.

1.3.1 Trends and Advances

The policies for Secondary Planning are consistent with policies outside the Niagara Region. Many municipalities are coordinating the preparation of Secondary Plans with Subwatershed Planning (refer to **Section 4.0).**

1.4 Servicing, SWM Requirements and Sediment and Erosion Control

The OPs reviewed generally addressed SWM requirements for development. The following are some typical policies found in OPs for municipalities across the Niagara Region and the NPCA watersheds:

- Prior to the approval of any development application, the County may require the preparation of SWM plans;
- Policies provide general criteria to be considered for adequate SWM facilities when reviewing applications for development;
- Detailed SWM studies that provide for erosion and water quality and quantity control shall be required,
- All new development and redevelopment shall be served by a storm drainage system that is satisfactory to the municipality and NPCA;
- SWM plans shall be in accordance with existing Master Drainage Plans;
- Develop comprehensive SWM plans for development in urban areas;
- Development taking place in isolated areas outside urban areas shall require SWM plans that incorporate on-site control techniques for quality and quantity control;
- SWM plans shall be designed at a minimum to MOE standards;
- Policies recognize the need to protect rivers and creeks from destructive effects of stormwater runoff and that SWM plans need to be carried out in consultation with NPCA and Niagara Region to assess downstream constraints;
- A SWM plan and sediment and erosion plan shall be required with a development application depending on the scale of the development proposal and environmental conditions;
- SWM plans shall be prepared in accordance with MOE standards and where a Environmental Impact Statement is being prepared for the development, the SWM plan shall be coordinated with, and integrate any recommendations of the Environmental Impact Statement;
- Accommodate the major and minor system;
- Storm drainage to be constructed completely separate of sanitary sewers;
- Plans must include a SWM plan, including lot grading, drainage, erosion and sediment control plans, in accordance with MOE;
- Maintenance of groundwater quality and flow and storm base flow;
- Protecting water quality and aquatic species and their habitats;

- Prevention of channel erosion and flood risk;
- Minimize disturbance to existing drainage patterns;
- SWM report, including sediment and erosion control plans, to be submitted with an application for development in accordance with Niagara Region policies, MOE and existing environmental planning studies;
- In accordance with Secondary Plans;
- New development and redevelopment in urban areas shall generally proceed where the development is fully serviced by adequate drainage and SWM facilities;
- All new development in non urban areas shall be subject to SWM practices;
- SWM studies will be required for development proposals;
- In all instances the need for SWM facilities will be determined by the municipality, NPCA and any other agency having jurisdiction;
- SWM will provide provisions and methods to ensure that quantity and quality of runoff will not exceed pre-development levels or appropriate levels as determined by municipality, NPCA and other agencies;
- Stormwater will be managed on site and will have no adverse impacts on adjacent properties;
- Prohibit combined sewers and recommends separating existing systems;
- SWM ponds are prohibited within key heritage features and key hydrologic features or their vegetation protection zones;
- Where appropriate an integrated approach is used to minimize storm flows and structures by such measures as discharge controls and conveyance techniques on individual lots;
- SWM plans shall comply with standards and targets of approved watershed plans and other relevant municipal studies relating to the provision for SWM;
- Sediment and erosion control is required during development and site alteration activities;
- Sediment and erosion control during construction; and
- Required to the satisfaction of the municipality, NPCA and other agencies construction methods and techniques which prevent and control pollution will be required (applies to public works also).

1.4.1 Trends and Advances

OPs typically acknowledge the effects of stormwater on water quality and quantity and the need to implement SWM with new development and redevelopment. They typically require that the proponent must use BMPs for sediment and erosion control to mitigate the impacts of development. Then list construction mitigation measures that address slope stability, soil erosion, surface drainage, infiltration, and water quality.

City of Vaughan OP policies require that any development or change in land use near or adjacent to an existing or potential fish habitat area shall be reviewed by the MNR and City with respect to its potential impact. Any proposal will be subject to an evaluation to determine if it will result in a reduction of the environmental functions, attributes, or linkage to the stream system which could impair aquatic health. The *Fisheries Act* may be applied to a development where negative impacts are indicated.

Other municipalities include policies in their OP that require the proponents to design and undertake a monitoring program for construction sites to ensure that sediment controls are effective during construction and after landscaping. These policies are then adopted under a by-law so that they are enforceable.

1.5 Municipal Drains

Municipal drains provide the basic drainage infrastructure for many of the rural areas, and some urban areas, located within the Niagara Region and the NPCA watersheds. Some municipalities have included policies within their OPs to address the need for incorporating BMPs into municipal drainage works. Section 3.3

provides a more detailed discussion on the *Drainage Act*. The following policies are written into OPs to address the need to consider water quality and quantity with respect to municipal drains.

- Open and closed municipal drains will be designed, constructed and maintained to reduce negative effects on the environment;
- Supports municipal drainage projects that include BMPs; and
- Determine what design requirements are necessary to eliminate, mitigate or compensate for adverse effects on fish habitat.

1.5.1 Trends and Advances

Drainage engineers should consider opportunities for implementing BMPs in cooperation with stewardship councils that can provide grants for the creation of wider drain buffers, vegetative plantings, and other water quality improvement techniques. The unique challenge with implementing BMPs under municipal drain projects is that the landowners within the watershed pay the cost of the drainage works. Reducing future maintenance costs through the implementation of BMPs is a good way to promote sustainable land use practices to landowners sharing a portion of the cost.

Norfolk County has implemented the Wetland Drain Restoration Project on municipal drains for a number of years. Wetland enhancement or restoration works are included in the drain design and protected under a by-law.

1.6 Design Principles and Urban Design Guidelines

Several municipalities identify the need for council to plan and adopt design guidelines that proponents and professionals are to consult when carrying out development. Several OPs make reference to smart growth principles and the Niagara Region's Model Urban Design Guidelines.

> *"The Model Urban Design Guidelines were developed to provide design principles and specific guidelines for a range of development types and conditions relevant to the Niagara Region. The guidelines are being made available by the Region as a reference material for local adaptation and adoption. It is hoped that over time, local municipalities will share success stories with the Region and one another to perpetually improve this set of Model Guidelines. The application of each guideline or guideline component alone does not constitute Smart Growth. It is the application of the principles and related guidelines collectively which, over time, will result in the implementation of Smart Growth."*

Several of the municipalities identified specific SWM BMPs that were rooted in Smart Growth principles and the LID philosophy. These types of policies provide the opportunities to implement innovative design in the Niagara Region and the NPCA watersheds by going beyond conventional land use planning policies. The following are some examples of polices that have been describe in OPs across the study area:

<u>Parking Standards</u>

The more recently updated OPs describe policies that promoted reduced impervious areas and incorporate more landscaped features within parking areas.

- Support reduce parking through shared parking and the need for parking studies;
- Encourage the efficient shared use of parking, loading, and storage areas;
- Peripheral plantings and landscaped islands in parking lots will be encouraged for private parking lots;
- Require tree planting within municipal parking lots, peripheral planting, and islands;

- Discourage barren parking lots by requiring vegetated islands and periphery landscaping;
- Encourage landscaping in parking areas using salt tolerant species;
- Institutional and commercial parking should be broken down into pods with planting strips;
- Minimize parking surfaces to greatest degree possible;
- Provide interim policies that may be amended subject to detailed parking studies; and
- Minimize parking surfaces to greatest degree possible.

These types of land use policies provide the opportunity to advance even further and look at the potential of implementing LID practices such as bioretention areas in parking lots and incorporating more vegetation. The vegetation component helps to intercept rainfall that would otherwise come in contact with the paved surface and transport pollutants into the storm sewer. These types of policies fit well with the Model Urban Design Guidelines.

Road Standards

Other examples of sustainable land use policies include flexibility in road standards that promote a more compact urban form.

- Alternative road standards may be accepted for compact urban form; and
- Reduced road ROW may be permitted (*i.e.*, one way streets).

Narrower road allowances help to reduce impervious cover. Many studies have shown that increases in impervious areas significantly impair the natural and water resources within watersheds.

Innovative SWM Design Standards

- Where appropriate an integrated approach is used to minimize storm flows and structures by such measures as discharge controls and conveyance techniques on individual lots;
- Quality control through ponds and/or lot level controls;
- Underground storage may be permitted;
- Naturalized methods;
- Design Guidelines for Tree Planting planted to form canopy over roads when mature which would improve interception, but still must accommodate street lights and roadway illumination;
- Should be designed as integral features of the landscape;
- SWM channels located in parks could be meandered and natural;
- Where appropriate an integrated approach is used to minimize storm flows and structures by such measures as discharge controls and conveyance controls on individual lots; and
- Encourage infiltration to maintain base flow through grading

All of these policies provide municipalities with the opportunity to maximize SWM at the site level.

Urban Form Standards

- The clustering of housing units for retention of existing trees and vegetation;
- Allow alternative patterns to preserve and enhance natural features found on site;
- Retention of existing trees and vegetation;
- Preservation and enhancement of natural features found on site;
- OP provides goals of the secondary plan such as ‘flexibility to adapt to new development trends’;
- Innovative housing will be considered by OP amendments; and

- Preserve and enhance natural features found on site.

Standards such as clustering of housing units is another example of a LID principle that looks at reducing road length and providing flexibility to integrate existing natural features into the landscape.

1.6.1 Trends and Advances

Further direction could be provided that not only recommends shared parking but looks at utilizing underground parking and above ground parking structures to reduce impervious areas.

The following are examples of policies used in OPs of municipalities outside of the study area:

- Absorb rainfall where it falls;
- Reducing the adverse effects of stormwater and snowmelt based on a hierarchy of watershed based wet weather flow practices;
- Utilize practices that recognize that wet weather flow is best managed where it falls, supplemented by conveyance and end-of-pipe;
- On site facilities are not always feasible in which case alternative management solutions will be considered;
- Evaluate the use of source controls in parking lots and other large paved surfaces such as oil/grit separators;
- Innovative energy producing options, green industry and green building design and construction practices will be supported and encouraged in building renovation and redevelopment through innovative methods of reducing stormwater flows and green roofs;
- Redevelopment of Brownfield sites should consider green roof technology;
- Investment in community improvements by public agencies, or public/private partnerships such as rooftop gardens;
- Development in mixed use areas will be encouraged to incorporate environmentally sustainable building design and construction practices that reduce stormwater flows, and create innovative green spaces such as green roofs and others;
- Development and/or site alteration proposals shall minimize impervious areas and maximize natural areas to minimize water quality and quantity impacts;
- Prepare and adopt guidelines for SWM that shall be used to improve existing drainage patterns and facilities, and that shall be considered where development and/or site alteration of existing lots and for infilling is proposed; and
- Provisions for swales and on-site ponds.

1.7 Plans of Subdivision, Site Plan Control and Approvals

The OPs describe when development or redevelopment falls under site plan control. Typically, commercial development and redevelopment will be subject to site plan control. Exemptions to site plan control include any alteration or addition to an existing one unit or two unit dwelling, or any new one or two unit dwelling. Site Plan control is an important means of encouraging well designed, functional, and universal development. Many of the OPs describe the conditions in which development and redevelopment will be subject to plans of subdivision, site plan control, and which developments/redevelopments are exempt.

The following are some sample policies relating to plans of subdivision, site plan control, and approvals:

- The Subdivision and Condominium Plan approval process will be used to ensure that the policies of the OP and applicable Secondary Plans/Neighbourhood Plans are incorporated into new development areas;
- Council will only approve plans of subdivision or condominium conforms with the policies and that adequate servicing, such as stormwater drainage, can be provided;
- Rural residential development site should not have detrimental effects on water quality and quantity;
- Estate residential development requires an Environmental Impact Statement;
- Town to establish uniform site plan control policies;
- Plans of subdivision and site plan control require the same types of studies; and
- Council may establish a by-law that explains what classes of development will be exempt from site plan control.

1.7.1 Trends and Advances

Municipalities support the use of Site Plan Agreements. Municipalities are struggling with how to address infill and intensification situations realizing the cumulative impacts they have on water quality and quantity.

Other municipalities are amending their OP to include SWM policies that address provincial BMPs, infill and intensification situations, green building standards and the Town's Development Engineering Regulations.

1.8 Greening and Ecological Policies

Many municipalities, through the OPs, support policies that provide indirect stormwater benefits by retaining natural features and educating the public about BMPs for reducing pollution of stormwater runoff at the source. The following are some examples of policies described in OPs within the Niagara Region and the NPCA watersheds:

- Maintain, protect, and enhance riparian cover in headwaters and along streams;
- Existing sources of water pollution will be reduced and eliminated where possible;
- Recommend protecting and incorporating existing natural areas into open space system;
- Tree and woodland protection and reforestation;
- Best to protect existing natural features where feasible;
- Street Tree Management Policies;
- Supporting and promoting environmental stewardship;
- Tree cutting by-laws;
- Conservation easements;
- Property tax incentives;
- Naturalization of SWM facilities; and
- Support agencies, community organizations, and private landowners in their efforts to protect and enhance through private habitat restoration, and stewardship, land trusts, public acquisition, conservation easements, property tax mechanisms.

Municipalities encourage individuals and private industry to follow these policies.

1.8.1 Trends and Advances

The Alternative Land Use Services (ALUS) is a program that rewards farmers for the positive contributions they make to clean air and water and biodiversity through their land management practices. The program promotes

the protection of ecologically sensitive areas, establishing riparian buffers (that filter and treat runoff before entering a watercourse), and protecting and enhancing wetland habitat.

As mentioned earlier, wetland restoration projects that would utilize ephemeral draws to impound surface water and enhance SWM. Municipalities are encouraged to investigate options in both urban and rural areas for protecting and enhancing wetland habitat, and their flow moderating roles.

Municipalities could explore wetland enhancement and restoration in partnership with organizations such as the Wetland Habitat Fund who provide technical assistance and funding for projects on private and public lands.

1.9 Monitoring

There were very few policies observed in the OPs that identified the need for monitoring of watersheds in order to help make informed decisions regarding land use and development. **Section 13.0** provides a detailed discussion on the components of a typical monitoring program.

With the exception of the City of Hamilton, which included policies for monitoring programs that support land use planning, there is a need to amend existing OPs to include policies for municipalities to conduct monitoring programs.

The City of Hamilton, supports through the OP field studies and developing a monitoring plan in cooperation with the CA to support land use planning and resource management decision making.

There was also a lack of policies that encouraged the monitoring and maintenance of SWM facilities to ensure they are performing as intended.

1.9.1 Trends and Analysis

Municipalities are currently conducting watershed monitoring programs in order to make informed management decisions with respect to land use and development. The monitoring programs include measurements of water quality, quantity, and aquatic habitat parameters to determine the health of the system. This information is useful for identifying what types of land uses and activities are impacting watershed health. Municipalities have also used the monitoring information for SWM design specific to their watershed conditions.

Other municipalities have included policies in the OP to continue monitoring stormwater runoff and receiving water bodies for quality impacts resulting from increased urbanization.

The City of Chilliwack has included in their OP a policy that the town shall implement an ongoing inspection program to ensure all stormwater control measures are meeting their intended goal.

1.10 Source Water Protection

Municipalities carry out source water protection studies to ensure future development does not impact ground and surface water quality and quantity. The OP will then be amended to reflect the results of these studies.

Several OP require that development or site alterations shall be restricted around sensitive surface water features and sensitive groundwater features. The policies require that additional studies, such as source water protection plans, be prepared to demonstrate that sensitive hydrogeologic features are protected, improved or restored through appropriate measures and/or alternative development approaches.

APPENDIX Q
Detailed Review of Design Standards and Policies

APPENDIX Q – MUNICIPAL DESIGN STANDARDS AND POLICIES

1.1 Water Quantity and Quality Control Targets

Current practices relating to water quantity targets within the Niagara Region and the NPCA watersheds include:

- The MOE *Stormwater Management Planning and Design Manual* (2003);
- 'Zero increase in peak runoff policy';
- Targets specific to watershed and subwatershed studies and Master Drainage Plans;
- Where no Master Drainage Plan exists, the policy is to require pre flow equals post flow;
- Quantity control per Director of Public Works or MOE *Stormwater Management Planning and Design Manual* (2003);
- If it can be demonstrated through the use of modelling that additional flow will not cause downstream detrimental affects;
- Any deviation from policies will need to be supported with detailed analysis;
- Where redevelopment is proposed provisions for water quality control will be on a site specific basis; and
- Provisions for water quality on a site specific basis.

1.1.1 Trends and Advances

Municipalities outside of the Niagara Region tend to take a similar approach for setting water quality and quantity targets. Targets are often set using storm drainage criteria based on the local constraints of receiving systems (*e.g.*, fisheries sensitivity), Subwatershed Studies and Master Drainage Plans, MTO guidelines, the outlet capacity, pre to post where capacity is not known, and the MOE guidelines.

Refer to **Section 6.0** for further discussion and proposed policy direction relating to water quality and quantity targets.

1.2 Watercourse Erosion

Municipalities within the Niagara Region and the NPCA watersheds are using the following criteria and targets for erosion protection of watercourses:

- In accordance with watershed or subwatershed studies;
- NPCA policies;
- If no studies, apply MOE *Stormwater Management Planning and Design Manual* (2003) guidelines;
- Demonstrate through modelling to show there will not be negative effects;
- Assessment of critical flow values;
- Critical velocity or shear force;
- MNR *Natural Hazards Technical Guidelines* (2003);
- Extended detention storage for the 25mm storm;
- Assessment of downstream erosion susceptibility and critical flows using event based modelling; and
- Assessment of downstream critical velocity and shear forces in conjunction with continuous simulation modelling (duration analysis).

1.2.1 Trends and Advances

Some municipalities require additional extended detention for erosion/stream morphology and attenuation control to comply with council approved subwatershed plans. In the absence of a subwatershed study and Master Drainage Plan, the minimum control is $40m^3$/ha as per the MOE. Municipalities that have conducted geomorphic or stream erosion studies and have identified downstream erosion problems site specific requirements for erosion control will be required.

Refer to **Section 6.0** for further discussion and proposed policy direction relating to erosion targets.

1.3 Hydrogeological Sensitive areas

The NPCA Groundwater Study was initiated to characterize the groundwater resources within the NPCA watersheds. The study identified groundwater vulnerable areas and potential risks to groundwater contamination from existing and future land uses.

Information from this study has been incorporated into **Section 6.0** which offers policy direction relating to hydrogeological sensitive areas.

1.3.1 Trends and Advances

Other municipalities are also initiating water resources protection strategies to protect and preserve water supplies. These studies are important when planning SWM and considering potential threats to groundwater, especially when infiltrating surface water.

Municipalities are using the information and recommendations from these studies to make management decisions such as where to target salt reduction programs for roads located within hydrogeologic sensitive areas. This has also lead municipalities to explore road design standards that reduce the need for salt. The information has further assisted with developing policies and by-laws related to snow disposal to avoid such activities in areas vulnerable to groundwater contamination.

Municipalities such as the City of Guelph that rely entirely on groundwater as their drinking water source have specific policies to encourage groundwater recharge in SWM design. The policies do require that the potential impacts on water quality and quantity be assessed for any proposed SWM techniques on the regional aquifer or municipal water sources.

Refer to **Section 6.3** for further discussion and proposed policy direction relating to Hydrogeological Sensitive areas.

1.4 Hydrologic and Hydraulic Analysis

Refer to **Section 7.0** for further discussion and proposed policy direction relating to hydrologic and hydraulic analysis.

1.5 Minor and Major System

The minor system varies across the Niagara Region and the NPCA watersheds, ranging from 2, 5 and in some cases 10-year for some commercial areas at the discretion of the engineer. The major storm event for all design standards reviewed is the 100-year storm.

The MTO manual indicates that local municipalities set the minor system criteria. Municipalities should standardize the minor system criteria within NPCA. The major system is set by provincial criteria, administered by the NPCA, namely regulatory protection of property and buildings.

Section 7.0 provides further discussion on hydrologic analysis and the design of the major and minor drainage system.

1.6 Spill Management

The general, policies pertaining to Spill Management Plans for municipalities in the Niagara Region and the NPCA watersheds are required for all industrial and commercial lands that process, store, or refine liquid.

1.6.1 Trends and Advances

Municipalities are taking advantage of opportunities when planning capital projects such as road reconstruction and storm sewer replacement to implement BMPs in the minor system. Coordinating stormwater improvements in conjunction with road reconstruction is a cost effective way to install controls such as oil and grit separators. Some municipalities incorporate oil and grit separators into storm sewer systems installing at the last catch basin to treat road runoff. The installation of oil and grit separators is also useful for controlling potential spills.

The NPCA Groundwater Study provides details on spill management and contingency planning. The report also provides records of MOE report spills and the type and location where they occurred.

See **Section 6.2.4** regarding consideration of spill potential in development plans.

1.7 Foundation Drains

Many municipalities are concerned about foundation drains connected to the storm sewer system. The practice in the past has led to foundation damage and basement flooding from hydraulic pressure when the storm sewer becomes surcharged. Minor systems are designed to accommodate flow from storm events of 2 to 10-year return periods. When these flows are exceeded, surface water will naturally find a flow route in the major system. During these major system events, water is restricted by the inlet or pipe capacity from entering the storm sewer. However, the hydraulic pressure in the storm sewer is often at the level of the surface, resulting in the same hydraulic pressure in the foundation drain. To prevent this occurrence, typical policies regarding foundation drains have been adopted including:

- Single residential to be directed to grade if soils are conducive;
- Row or town homes may be connected to the storm sewer;
- Foundation drains may be connected to foundation drain collectors (third pipe or FDC), storm sewer or discharged to ground;
- For new development, the foundation drains must be pumped to the sewer and not by gravity;
- Connect to storm sewer but must provide good reason;
- Use third pipe approach;
- Provide hydraulic analysis to support connection to the storm sewer;
- Connections to storm drains are expressly prohibited; and
- Sump pumps are to be discharged to grade “in a manner that would not cause erosion or inconvenience to neighbours”.

1.7 Trends and Advances

Third pipe systems designed to drain foundations and convey the water to a separate outlet have been implemented across Ontario. Developments constructed adjacent to a sensitive watercourse include a third pipe that conveys foundation drainage separate of the storm sewer, by-passing the stormwater facility directly to the stream.

1.8 Roof Leaders

Typical policies regarding roof leaders include:

- Connection to storm and sewer prohibited;
- Drain to pervious surfaces wherever possible;
- To be discharged to grassed or garden areas;
- Commercial areas can discharge to storm sewer using controlled release devices;
- Disconnect where able; and
- Direct to splash pads and protect against erosion.

1.8.1 Trends and Advances

Municipalities recognize that roof water should be infiltrated to the ground and diverted away from impervious surfaces such as driveways wherever possible. The use of rain gardens is a practice where roof leaders are discharged into landscaped areas that can be designed in such a way as to create a depression that collects rainwater and allow it to gradually infiltrate into the ground. Consideration must be given to ensure they are situated far enough away from the home to prevent damage to the foundation. They also need to drain within a specific period of time to prevent standing water concerns. Methods such as this are an excellent way to infiltrate clean rainwater.

Some municipalities offer free downspout disconnections to help alleviate pressure on combined sewer systems. Disconnecting roof leaders helps reduce the risk of basement flooding and provides the opportunity to detain and infiltrate a portion of the roof water depending on the soil type.

1.9 Combined Sewers

Niagara Region's *Water and Wastewater Master Servicing Plan Update* (2003) notes that combined sewer systems are still active in Niagara-On-The-Lake, St. Catharines, Welland, and Niagara Falls. The combined sewer overflows from these municipalities release large amounts of sanitary sewage mixed with stormwater that includes bacteria, oxygen demanding substances, heavy metals, and industrial chemicals. The pollutants cause problems for bathing beaches, aquatic life, and potentially water supplies. The report recommends that the MOE control policy outlined in Procedure F-5-5: Determination of Treatment Requirements for Municipal and Private Combined and Partially Combined Sewer Systems be adopted. This would lead to control of 90% of the wet weather flow in a combined system. Control options that can be used include many of the measures typically used for SWM such as: roof leader/foundation drain disconnection; sewer separation; in-line and off line storage; high-rate treatment of overflows with disinfection; sewer rehabilitation; and replacement to reduce inflow and infiltration.

It is a concern that combined sewer separation might lead to untreated storm sewer discharges to the waterways. It is recommended that measures that control the total discharge be favoured, or that stormwater be controlled

separately to a minimum level of treatment to provide a normal level of protection for fisheries (70% TSS removal).

1.10 Natural Watercourses

The following summarizes some of the policies currently in use relating to watercourse alterations:

- Reference the MNR adaptive management of stream corridors in Ontario 2001
- Permits from NPCA and DFO for watercourse alterations;
- Consider maintenance requirements (*e.g.,* utilities);
- Multi-disciplinary design approach;
- Utilize guidelines such as MNR, Rosgen, Annable, and Newbury;
- Erosion control measures must preserve natural valley aesthetics;
- Protection could be required to the 1:100 flood level;
- Where control of flow is not feasible or ineffective, design of channel alterations may be considered; and
- Design according to *Natural Channel Design Principles* (1994).

1.10.1 Trends and Advances

Municipalities are conducting geomorphic inventories or stream erosion studies of all streams within their jurisdiction. The studies help to prioritize restoration projects based on both risk to public safety and environmental enhancement.

Municipalities that have policies stemming from watershed studies require that softer erosion and stabilization methods such as soil bioengineering practices be considered first when altering or stabilizing a watercourse. Channel hardening techniques such as amour stone are sometimes required depending on space requirements and locations of utilities.

The City of Vancouver, through their sewer separation program, is taking the opportunity to daylight streams or create artificial streams when replacing aging sewer infrastructure. The City examines the possibility of constructing open watercourses rather than expensive storm sewers when the opportunities exist.

1.11 Storm Outfalls

Several municipalities have developed policies relating to stormwater outfalls into watercourses. The following summarizes some of the policies currently in use:

- Outfalls to be designed to prevent erosion;
- Prevent access by public (grates);
- Require permits from the NPCA;
- Outlets to be designed to dissipate energy to not cause erosion and supported with design calculations;
- Designed to be aesthetically pleasing;
- Appropriate bank scouring protection;
- Drop structures for steep valleys;
- Must not interfere with natural channel forming processes;
- Installed above the normal water level;
- Place on a skew with flow;
- Dynamic beaches and potential obstruction considerations (*i.e.*, damage from sheet ice); and

- Design as per MNR *Natural Hazard Technical Guidelines* (2003).

1.11.1 Trends and Advances

Municipalities such as the Town of Halton Hills have developed inspection programs to protect against liability for outfalls that could be in contravention of the OWRA and *Fisheries Act*. Currently the Town is conducting an inventory of free/uncontrolled outfalls and then implementing programs to retrofit. This could involve diverting a storm sewers outfall into a SWM facility to provide both water quality and quantity treatment. Other practices include providing upstream BMP techniques to provide some level of treatment such as oil and grit separators. These types of studies are often coordinated with other studies such as stream erosion inventories. During dry periods storm sewers can be monitored and sampled to identify upstream pollution problems such as cross connections from the sanitary sewer to the storm sewer. These 'suspect outfalls' can then be investigated further to determine retrofit potential.

1.12 Lot grading criteria

Lot grading criteria and standards were consistent across the municipalities and in other jurisdictions. The criteria typically included minimum and maximum grades for swales, the maximum area that can contribute to rear and side yard swales, the required side slopes and grade, maximum depth, minimum grade, maximum velocity, desirable minimum grade of swales, and absolute minimum grade of swales.

Lot grading is one of the main factors in deciding if stormwater source and conveyance controls can be implemented. In order to detain water at the site level, the criteria and standards will need to be relaxed to allow unconventional approaches to be applied. The creation of depressional pockets at the lot level can be integrated into the landscaping of the site. Most residential homeowners maintain their property as manicured lawns. Convincing homeowners to designate all or portions of their property as naturalized landscape features will make it easier to create features that are aesthetically pleasing, and function to enhance water quality and quantity.

The objective of the policy is to encourage lot grading criteria that help to detain and treat stormwater as part of the overall stormwater treatment train process at the lot level. Alternative lot grading criteria should be developed that will make implementing innovative SWM techniques easier and meet the Ontario Building Code. Consider restricting heavy equipment access throughout the site especially in areas with high infiltration potential to maintain the infiltration capacity soils. Roof water should be controlled on site through practices such as rain gardens, soak away pits, and infiltration trenches. In addition, site disturbance should be decreased from building foot print, large lot developments, such as rural estate lots, should aim for native vegetation coverage of 65%, and orientate the long axis of the building along topographic contours to minimize cutting and filling (Puget Sound Action Team, 2005).

Where appropriate, municipalities should encourage the use of alternative landscaping techniques over turf, such as naturescaping, that incorporates a diversity of native vegetation. Landscaping using native drought resistant species helps to reduce water consumption by reducing the need to irrigate. Landscaping with trees and shrubs rather than grass, and creating subtle depressional areas, will help to detain and treat stormwater at the site level.

The use of enhanced swales or bio-swales when designing backyard swales to convey stormwater runoff as an alternative to the conventional grass swale should be promoted (*e.g.,* features such as wetland pockets could be incorporated into the swale design to detain and enhance treatment performance). Consider specifying a minimum 300mm depth of topsoil to line drainage swales to act as an absorbent layer.

Compact soils that are not amended with a soil conditioner can be similar in nature to impervious areas. Recommend that lot grading consider soil amendments to ensure infiltration of stormwater. Conditioning soils with compost will increase the organic matter content of the soil. The organic matter acts a sponge and absorbs rainfall that helps to trap and store water which means less stormwater is running off the site. The organic matter also helps treat the stormwater and remove pollutants and enhance water quality.

Easements on new development and redevelopment sites should be established to access SWM facilities to deal with reported problems if the landowner is not taking the appropriate actions.

It is very important that the public is educated on the importance of source and conveyance controls to understand their role in SWM and protecting water quality and quantity. Since these types of SWM measures are more difficult to maintain, it will be important the landowners are aware of their significance.

See **Section 1.28** for further discussion and policy options for the development of alternative design criteria and standards.

1.12.1 Trends and Advances

Municipalities are exploring ways to implement at source controls at the lot level. Many municipalities utilize at source controls such as soak away pits where soils have high infiltration rates. The challenge with on site controls is ensuring that they remain in place and are maintained. As properties change hands, these sorts of features could easily be modified without the municipality being aware. Education plays an important role to ensure that stormwater BMPs are maintained and remain unaltered.

If municipalities are encouraging at source control BMPs, they need to provide lot grading guidelines that are conducive to these methods.

Municipalities are recognizing that in order to reduce the impacts of development taking place in sensitive subwatersheds alternative engineering standards will need to be explored to improve stormwater quality.

1.13 Reverse Driveways

Generally, reverse driveways are not to be connected to the storm sewer unless they are above the hydraulic grade line. Most municipalities discourage the use of reverse slope driveways since they capture runoff and fail to drain during major rainfall events. For new developments, reverse driveways are not permitted.

1.14 Cash-in-lieu Policies

Municipalities may consider cash-in-lieu policies:

- Funds to be transferred to priority retrofit sites;
- Cash-in-lieu to be used off site where it would be more effective, if the receiver is a low sensitivity, limited rehab opportunity, small or infill development;
- To calculate the rate, will need to determine the impacts on water quality and quantity;
- Where redevelopment is proposed, provisions for water quality control will be on a site specific basis;
- Areas where prepared and approved subwatershed plans exist, the guidelines and criteria will be adopted by the development proponent;
- Cash-in-lieu for off-site improvements; and

- Master plan approach to compensation towards off-site works is advocated.

Section 14.0 provides a detailed discussion on stormwater funding sources.

1.14.1 Trends and Advances

Two examples of cash-in-lieu are provided by the Town of Uxbridge and The City of Kitchener.

Uxbridge Urban Area Stormwater Management Study (TSH 2000)
The primary goal is to control phosphorus loadings to Lake Simcoe because of the eutrophic conditions of excess algae growth within the lake. This results in depleted oxygen levels in the bottom waters of the lake, placing severe stress on the important fishery. In addition, loading targets are aimed at reducing phosphorus levels in the Uxbridge Brook itself and in Wagner Lake downstream from the Uxbridge Urban area. Uxbridge Brook is a Policy 2 area for consideration of TP discharges from an expanded sewage treatment plant.

Uxbridge required a specific amount of phosphorus to be removed each year. Targets were established in conjunction with the MNR, MOE, local CAs, and the Township/City. Evaluation of existing conditions and removal efficiencies provided a starting point for establishing the targets.

The study followed a systematic process to develop a preferred plan of action. The approach includes the following steps.

- Identify technologies for retrofit, including costs and performance;
- Identify suitability criteria for options;
- Review locations for retrofit and establish suitability;
- Review other opportunities to add existing areas to new developments;
- Establish costs and performance;
- Carry out screening and ranking of options based on unit cost for phosphorus reduction;
- Identify additional factors for each measure such as land ownership and availability; and
- Recommend an approach.

Retrofit practices refer to adding stormwater quality elements to an existing drainage system. This could include adding stand-alone elements, such as ponds and oil grit separators, or upgrading existing ponds by adding sediment forebay or filtering modules.

In addition, pollution prevention at source is considered, since this type of activity also reduces pollution.

<u>Types of Upgrades</u>

a) To an existing pond:
- Forebay – Addition of an inlet forebay can increase sediment (and TP) capture by 10% and allow for easier maintenance. Area requirement is approximately 10% of the existing pond area;
- Baffles – Round shaped ponds with inlet close to the outlet lead to short circuiting and reduced performance. Baffles or berms can offset this effect and provide improved performance. Performance is 10% improved efficiency. The area requirement is: baffles - 0%; berms - these take up volume, so an allowance of 5 to10% area should be made;
- Outlet filter – Addition of an underdrained filter will increase performance by 20 to 30%. High flows will be bypassed. Area requirement is approximately double the existing pond size;

- Outlet wetland – An outlet wetland will filter sediments and take up nutrients and improve performance by 30%. Area requirement is approximately double the existing pond size; and
- Expanded pond with wetland addition – The existing pond area can be expanded to allow for shallow wetland features, and it will improve performance by 30%. Area requirement is 30 to 40% of existing pond area.

b) Stand alone retrofits:

- New ponds – New ponds following the MOE Manual to Level 1 requirements can achieve up to 80% TSS removal and 60% TP removal. With additional wetland features or outlet filters, 80% TP removal can be achieved. Area requirement is dependent on the drainage area;
- Oil grit separator – Types with and internal or external bypass can achieve 60% TSS and 40% TP removal. There is extensive experience with this type of system in Ontario and elsewhere and good monitoring data is becoming available. Area requirement for these systems can be the road ROW as they have a small footprint;
- Filters – This type of system has been applied extensively in the US and very little in Ontario. Some systems can be supplied with media specific to phosphorus removal. Area requirement depends on filter type;
- Roof leader disconnection – Disconnection can reduce runoff flow volume by up to 20%. Flow is diverted to the ground and either infiltrates or evapotranspires. Any runoff receives filtering from the soil. The addition of rain barrels can enhance performance, making this more attractive to some and provide water conservation. Program acceptance can be improved with education and incentives. Some municipalities have enforced the disconnection with by-laws. Overall performance relates to impervious area of roof tops disconnected and soil type. Expect 20% TP reduction; and
- Open ditch enhancement – Existing ditch systems with driveway culverts provide reasonable environmental benefits. Often residents ask for upgrades to curb and gutter systems because of maintenance issues with the ditch and culvert. Alternate systems, which avoid curb and gutter, and also avoid deep ditches and culverts can be installed. These also improve infiltration and filtering action and enhance TP removal by 10% or more.

Evaluation of the existing SWM conditions lead to identification of potential retrofit locations. Potential retrofit situations included the addition of sediment forebays or baffle systems in existing ponds, upgrading quantity ponds to provide quality measures, and enhancement of existing roadside ditches.

A similar procedure was completed for new SWM measures. Potential locations for incorporating new ponds were identified, roadside exfiltration systems, roof leader disconnection, and OGS installation. In determining the potential locations for new ponds, aerial photographs were utilized to determine open space availability. In addition, storm sewer maps, where available, were utilized to determine outfall locations. Potential pond types included wetlands, wet ponds, infiltration ponds and filtration ponds. Groundwater vulnerability maps assisted in identifying potential areas for constructing an exfiltration system or infiltration pond.

Evaluation to determine the most appropriate SWM retrofit measure was completed on a cost per removal unit (e.g. dollars/kg of phosphorous removed, dollars/hectare, or dollars per percent load reduction of suspended solids). This evaluation required an assessment of each retrofit measure to determine the removal efficiencies achievable should implementation of the measure occur. By developing a cost per removal unit a comparison of alternatives based on cost effectiveness could be conducted. Life cycle costing based on the drainage system selection too was used for most measures (Tufgar et al, 1999). Ranking of projects was in increasing order of unit life cycle costs. Life cycle costs are the present value of all capital, operating, maintenance and replacement costs for the measure, as shown in Figure 2. The final results with the recommended construction program are shown in Table 2.

The recommended program included the measures identified above and also pollution prevention practices. An implementation committee was recommended to review progress and monitoring results and modify the program as required to meet targets. New developments were recommended to meet a target of 90% phosphorous removal, by maximizing use of infiltration measures. If the new developments could not achieve this target, an offsetting contribution to additional retrofit measures were recommended. Alternately, a cash-in-lieu approach was proposed as follows. For new developments, the difference in percentage between the achievable removal percentage and 90% will be contributed on a cash-in-lieu basis. The funds should be provided to the Lake Simcoe Region Conservation Authority to manage in a special fund for Uxbridge retrofit projects. The amount to be provided is $100/ha/% for each percentage point less than 90% phosphorous removal.

Kitchener Stormwater Management

The purpose of the City of Kitchener *Stormwater Management Policy Study* (TSH, 2001) was to create a SWM approach and policies that will provide guidance for future locations, design, and implementation of SWM facilities. The initial step in the analysis included setting the objectives to be met by SWM. An analysis of existing measures and opportunities for new measures and retrofit was carried out. The investigation of potential opportunities includes the evaluation of SWM measures available to provide a hierarchy of measures that could be considered. Options have been developed for consideration and the recommended approach is being currently developed.

Drainage through the City of Kitchener is provided by approximately 19 subwatersheds, however many of these are a tributary to one main watershed, Schneider Creek. All eventually outlet to the Grand River, which has been recognized as a significant fisheries resource, has been designated as a Heritage River, and is used both as a water source and receiving outlet for treated sanitary flows. Objectives to be met for SWM are provided through a series of subwatershed studies, master plans, and overall drainage area needs.

The various objectives are summarized to outline common elements to be provided. These include:

- Meet current water quality targets set by the City of Kitchener, the Grand River Conservation Authority, and Provincial Guidelines;
- Reduce loadings of contaminants to the surface waters;
- Increase flow to groundwater to maintain base flow and temperature regimes;
- Improve stream and riparian habitat;
- Maximize use of source control with pollution prevention and infiltration;
- Maximize efficiency of expenditures by emphasizing larger communal systems owned by the City; and
- Provide a net gain in fishery resources.

Details regarding the existing storm drainage, SWM, and creek system have been identified from available mapping, servicing reports, and design information. A detailed inventory of existing SWM facilities has been developed, including a database to evaluate the potential for retrofit opportunities. The common basis for evaluating SWM opportunities is adopted from the current MOE criteria approach. This involves consideration of the level of control available for fishery protection. This, of course, uses sediment removal as the primary measure of evaluation.

To summarize opportunities available in both new and existing development areas, the City has been broken down into seven categories. The categories are based on the presence of SWM facilities retrofit ability and potential for new facilities. The categories and the level of each is summarized in **Figure 1.**

This summary identifies the land area within the City that can be controlled through centralized SWM facilities (*i.e.*, Ponds). Centralized ponds are selected as providing the most long-term cost effective approach to providing SWM.

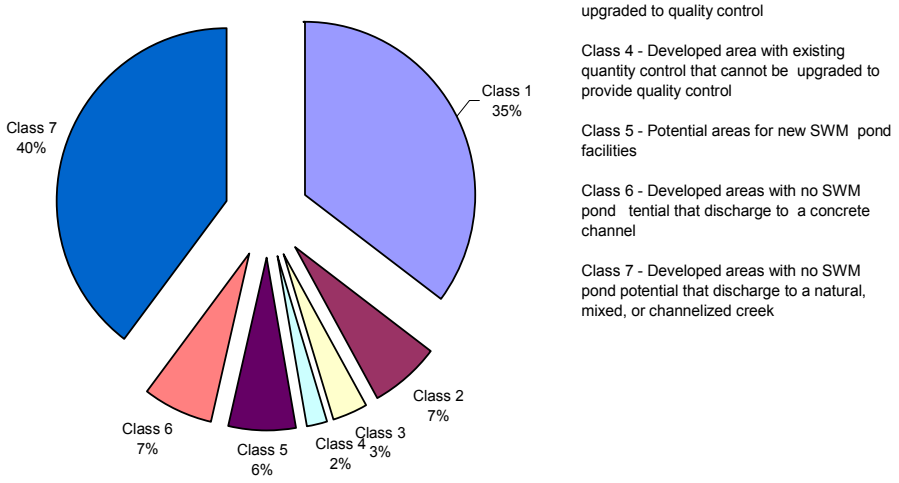
The analysis of the drainage system and outlets has also identified opportunities for:

- Oil/grit separator locations that will provide for control of approximately five hectares of land (the optimal drainage from a cost standpoint);
- Potential location of infiltration/exfiltration facilities; and
- The location of streams where rehabilitation could provide a significant enhancement to fish habitat and/or water quality.

Currently SWM opportunities are being evaluated further to identify where centralized measures could be provided and where site level controls provide the only available approach for SWM. Stream rehabilitation is being considered as a potential SWM measure in existing development areas where other opportunities are not necessarily practical (*i.e.*, high cost, low need for control, and land not available for controls).

Options are currently being developed and are summarized as follows:

Figure 1 - Classification of SWM Opportunities



Class 1 - Undeveloped area with SWM pond potential

Class 2 - Developed area with existing quality features to current criteria

Class 3 - Developed area with existing quantity control that may potentially be upgraded to quality control

Class 4 - Developed area with existing quantity control that cannot be upgraded to provide quality control

Class 5 - Potential areas for new SWM pond facilities

Class 6 - Developed areas with no SWM pond tential that discharge to a concrete channel

Class 7 - Developed areas with no SWM pond potential that discharge to a natural, mixed, or channelized creek

a) Apply the requirements for SWM across the City, regardless of the category for potential SWM. This would include:

- Centralized SWM facilities in new development areas;
- Centralized SWM facilities where possible for redevelopment or infill areas (retrofit existing, or new facilities);
- Centralized oil/grit separators where SWM ponds are not possible;
- Site level controls where centralized controls are not possible; and
- Stream rehabilitation for erosion control.

b) Apply the requirements for SWM in areas of new development and areas of highest potential for retrofit and infill. Carry out stream corridor rehabilitation in other areas:

- Centralized SWM facilities in new development areas;

- Centralized SWM facilities where possible for re-evelopment or infill areas (retrofit existing or new facilities);
- In areas of highest potential for redevelopment or infill provide centralized oil/grit separators or site level controls where SWM ponds cannot be provided; and
- Rehabilitate stream corridors in balance of areas (lowest potential for re-development of infill).

The potential decision for SWM measures to be applied, along with the policy approach, will include the consideration of costs and effectiveness, of available measures. The costs are based upon findings of recent comparison of the measures. This includes the findings of the Uxbridge Study outlined in this paper.

A policy approach will consider a decision making framework as outlined in **Figure 2.** This provides an approach for the first option being considered.

Funding opportunities and the approach for SWM measures will be included in the approach developed. This will be required for centralized facilities and possible stream rehabilitation.

Trends and Advances for in Cash-in-Lieu and Retrofit Studies

These studies represent the recent trends and advances summarized below. A future monitoring program is also recommended in order to assess the efficiencies and impacts of the additional SWM measures introduced. In all the studies, pollution prevention measures were considered including downspout disconnection, public education, and municipal operations, such as improved street cleaning practices.

- The cash-in-lieu approach for new developments needs to be tied to a plan to retrofit measures in the existing developed areas of the same municipality;
- The most cost effective retrofit measure is a dry pond to wet pond upgrade;
- Other measures in the road right-of-way take advantage of lower add-on costs;
- Decisions are being based on quantitative performance and cost to achieve overall objectives;
- Life cycle costing (present value) is considered the best basis for decisions;
- Drainage system selection tool (J.F.Sabourin for the Toronto and Region Conservation Authority) aids in retrofit analysis;
- Retrofit studies including flow reduction and pollution prevention options;
- Implementation includes annual review, maintenance program, and monitoring; and
- Database of facilities aids in analysis and long-term maintenance.

1.15 Centralized Systems

Large-scale SWM facilities are centralized systems and generally serve established cities and towns. Where appropriate, centralized systems are generally preferred to decentralized systems, as one centralized system can take the place of several decentralized systems. This makes centralized systems more economical, allows for greater control, requires fewer people, and produces only one discharge to monitor instead of several. However there are good reasons for use of decentralized systems and options should be evaluated on a case-by-case basis.

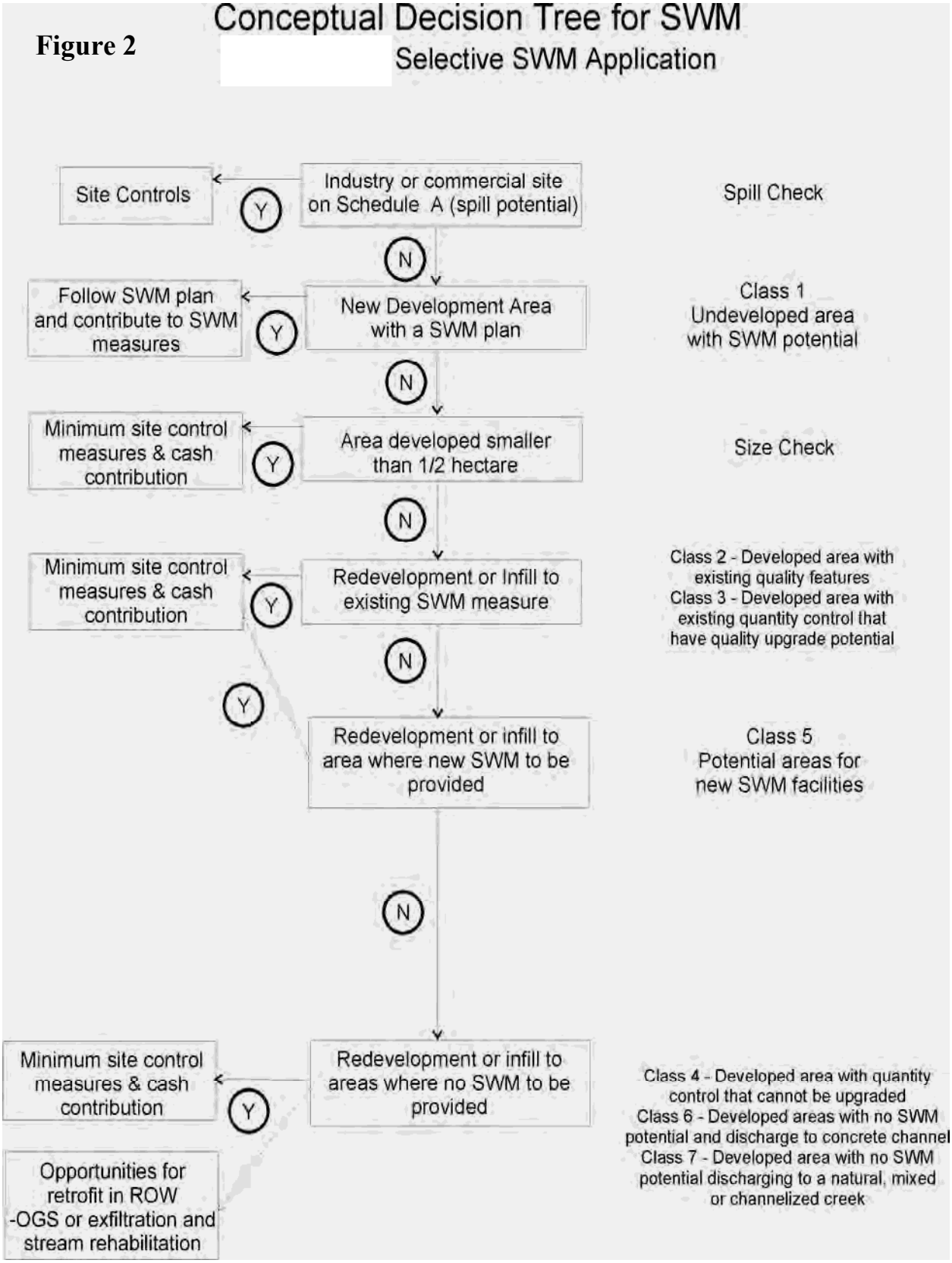
1.16 SWM and Passive Recreational Opportunities

Several of the municipalities indicate that consideration may be given for the potential integration of SWM ponds with recreational uses. Passive recreational uses identified included activities such as skating.

1.16.1 Trends and Advances

Many municipalities incorporate SWM facilities into recreational areas. Recreational uses are permitted such that they do not cause turbulence in the pond thereby re-suspending sediments.

Figure 2


Conceptual Decision Tree for SWM
Selective SWM Application
Industry or commercial site on Schedule A (spill potential)
Site Controls
Y
N
Spill Check
New Development Area with a SWM plan
Follow SWM plan and contribute to SWM measures
Y
N
Class 1
Undeveloped area with SWM potential
Area developed smaller than 1/2 hectare
Minimum site control measures & cash contribution
Y
N
Size Check
Redevelopment or Infill to existing SWM measure
Minimum site control measures & cash contribution
Y
N
Class 2 - Developed area with existing quality features
Class 3 - Developed area with existing quantity control that have quality upgrade potential
Y
Redevelopment or infill to area where new SWM to be provided
Class 5
Potential areas for new SWM facilities
N
Redevelopment or infill to areas where no SWM to be provided
Minimum site control measures & cash contribution
Y
Class 4 - Developed area with quantity control that cannot be upgraded
Class 6 - Developed areas with no SWM potential and discharge to concrete channel
Class 7 - Developed area with no SWM potential discharging to a natural, mixed or channelized creek
Opportunities for retrofit in ROW
-OGS or exfiltration and stream rehabilitation

1.17 SWM Facility Design and Landscaping Guidelines

The design and aesthetic guidelines that were reviewed in the available design standards generally follow the guidelines provided in the MOE *Stormwater Management Planning and Design Manual* (2003). The following list identifies some of the design and aesthetic design guidelines used across the Niagara Region and the NPCA watersheds:

- Identify the types of outlet control structures approved for use;
- The dimensions of the access road around the perimeter of the facility and the required number of access gates;
- Fencing requirements depending on the type of facility and associated grading (*i.e.,* maximum side slopes);
- Placement of inlet/outlet structures to discourage public access;
- Maintenance accessories such as trash racks;
- Maximum water depth under any condition; and
- Landscaping requirements (*i.e.,* seeding and sodding, and use of native vegetation).

1.17.1 Trends and Advances

Many municipalities across Ontario have taken the guidelines from the MOE *Stormwater Management Planning and Design Manual* (2003) and adapted them for their own needs. Municipalities are implementing naturalized methods for SWM facility designs using techniques such as biomimicry. To facilitate future maintenance activities, some municipalities are requiring sediment dewatering areas for new SWM facilities. **Appendices I** and **S** provide sample aesthetic guidelines and a plant list approved by the NPCA.

1.18 Stormwater Management Best Management Practices

The municipal standards provide potential BMP alternatives that should be considered when selecting the appropriate SWM technique. The following list summarizes some of the BMP approaches and specific BMP types accepted throughout the Niagara Region and the NPCA watersheds:

Several municipalities recommend considering applying stormwater BMPs techniques at lot level techniques and at source control, Transport or Conveyance control, and end-of-pipe.

- The policies highlight the fact that stormwater BMPs are more effective if applied at the source;
- Grass swales, ponds, roof leaders to grass, rooftop storage, and underground storage;
- Some policies permit temporary detention facilities within watercourses;
- SWM detention through roof top storage, parking lot detention, oversized pipes, and green area detention;
- Application of a BMP should be considered in subwatershed study or master plan;
- Reports must contain a statement by the designer indicating that BMPs were reviewed and utilized;
- Maintenance of hydrologic cycle is encouraged where soil conditions permit;
- Utilize SWM facilities to enhance or maintain infiltration;
- Active infiltration measures will be applicable with supporting soils information; and

- Endorse provincial standards for SWM.

The official plan policies encourage incorporating SWM controls into the fabric of the development. Clustering of development and consideration for at source controls for residential, commercial, institutional, and parking areas. These policies encourage application of the BMPs suggested by Niagara Region's Model Urban Design Guidelines.

1.18.1 Trends and Advances

Municipalities are using the treatment train approach to SWM which, in some cases, can lead to smaller pond facilities and obtain higher performance. Section 8.0 provides an overview of the various structural and non structural BMPs currently in practice across Canada, and provides further discussion on the treatment train approach. In some municipalities the SWM reduction benefits of at source controls is often not included in the SWM design calculations for the end-of-pipe facility. The reason being is that at source controls located on private lands are left to the landowner to maintain. The use of easements and agreements between the municipality and the private owner may be the best way for ensuring the lot level or at source SWM controls will be maintained, monitored, and protected (see section on SWM facilities on private lands).

Municipalities typically approve SWM ponds, oversized pipes, underground tanks, roof top storage, and hard surfaces such as parking lots. Some municipalities only permit storage in parking lots for frequent events up to the five-year level as it can hinder site access.

A water balance model was developed in British Columbia with the goal of restoring the natural water balance over time. The model can be applied at the lot level, subdivision and subwatershed scale to calculate the runoff reduction for various types of BMPs.

As discussed earlier, LID is a site design strategy that aims to maintain or replicate the predevelopment hydrologic conditions. BMPs such as rain gardens, bioinfiltration, bioretention, and green roofs help to capture, store and treat rainfall to simulate a predevelopment hydrologic conditions. Municipalities, such as the City of Waterloo, have implemented stormwater BMP pilot projects such as retrofitting the City Hall with a green roof. The City has also implemented a monitoring program in cooperation with community partners to measure the SWM benefits these technologies provide.

1.19 SWM Report Submission Requirements

See **Section 11.0** for information on SWM Report submission requirements.

1.20 Approvals

See **Section 12.0** for information on Approvals.

1.21 Erosion and Sediment Control Monitoring

Inadequate maintenance of accumulated sediment levels within the facility can lead to loss of performance over time in wet ponds and wetlands. The Town of Richmond Hill undertook extensive monitoring that showed the long-term sediment accumulation rate of 2.0 m^3/ha per year observed at stabilized catchments could increase by approximately ten fold during the early period of pond operation, in spite of active erosion and sediment control at the construction site. The relationship between sediment accumulation and age suggests that the first five-

years produce the highest rate of accumulation after the facility is constructed. This period corresponds in most cases with active construction activities in the catchment (Town of Richmond Hill, 2006).

The purpose of the erosion guidelines for construction sites is to provide developers, contractors and review agencies with a set of practical methods for ensuring that urban construction is carried out in such a manner that a minimum amount of soil is eroded from the site and deposited in downstream watercourses. An approach municipalities may take to resolve this issue includes requiring the builder to place securities to maintain the control measures stipulated in the plan and having the builder provide a street, catch basin, or pond cleaning program.

1.22 Development Monitoring of SWM Facilities

See Section 12.0 for information on Approvals.

1.23 Assumed SWM Facility Monitoring and Maintenance Programs

Several SWM policy and design guidelines for municipalities within the Niagara Region and the NPCA watersheds require that, as part of a SWM report submission, operation and maintenance manuals were required. The policies requested that the proponent provide sediment maintenance schedules before the facility would be assumed by the municipality. The policies also provided some standard maintenance activities and corresponding frequency.

There was some reference in the policies and standards reviewed to inspection, monitoring, and maintenance requirements for facilities assumed by the municipality.

1.23.1 Trends and Advances

Many municipalities implement routine inspection, monitoring and maintenance programs to ensure that the facilities are functioning as intended and that they are meeting the conditions of their Approval to Operate.

The programs provide procedures for sediment monitoring, inspection procedures and water quality sampling of SWM facilities and receiving streams. Continuous flow loggers or depth loggers are also used to record permanent pool depths and hydraulic performance. The procedures often outline the staffing and equipment needs, methods, required records and environmental consequences.

Maintenance and monitoring programs may involve creating a database of all existing assumed SWM facilities that can be routinely updated and used to prioritize SWM facility maintenance. To prioritize the maintenance work, the proponent should develop a system to prioritize maintenance work for facilities that the municipality owns and operates.

- Recommend that all municipalities develop a maintenance and monitoring program for all existing and future SWM facilities including a list of criteria for prioritizing maintenance; and
- All SWM facilities should be monitored after assumption to ensure continued hydrologic and hydraulic performance and meeting the conditions of the approval to operate.

1.24 Maintenance and Monitoring of Private SWM Facilities

Refer to **Section 16.3** and **Appendix T** for by-laws regarding maintenance and monitoring requirements for SWM facilities on private lands.

1.25 Redevelopment and Infilling

Municipalities, such as the Town of Fort Erie, have developed separate policies to deal with redevelopment and infilling for areas not subject to a subdivision agreement or site plan control. These policies ensure, for example, that the grading for the new development or redevelopment is compatible with the adjacent lands.

The Town of Grimsby has policies that require consideration of water quality controls on a site specific basis. If quality controls are not feasible, then the town may consider contributions in the form of a cash-in-lieu policy. The Town has prepared a Master Storm Water Quality Plan to identify stormwater retrofit locations to apply funds that were collected as cash-in-lieu. Section 1.14 this appendix provides policy direction regarding cash-in-lieu policies.

Section 6.4 provides examples of SWM control techniques typically used for redevelopment and infilling situations. The *Places to Grow Act* notes that "Municipalities are encouraged to implement and support innovative SWM actions as part of redevelopment and intensification". These policies also provide the opportunity to consider SWM for development and redevelopment that is exempt from site plan control.

SWM quantity and quality controls should be considered when redevelopment or infilling is proposed. When redeveloping a site, consider how SWM will be incorporated early in the design process to ensure adequate space has been reserved to provide an acceptable level of control.

The ultimate outlet for the drainage system should be the deciding factor as to what level of treatment is required. Section 13.4 provides further direction on how to determine the appropriate level of treatment based on the sensitivity of the receiving system. If the sensitivity of the receiving system is unknown, the level of treatment should meet levels set in the Sewer Use By-law or to the satisfaction of the municipality and NPCA.

1.26 Retrofit Studies

Refer to **Section 5.7** details on retrofit studies

1.27 Site Plan Control

Municipalities pass site plan control by-laws to designate site plan control areas. The by-law defines which development types are subject to site plan control which typically include industrial, commercial, institutional, and multiple residential units in excess of a defined number of units. The following is a synopsis site plan control developed by the Puget Sound Action Team (2005).

Site plan control is required for both new development and redevelopment and exceptions are typically placed on low density residential or building additions less than a specified surface area. The site plan control is important in that it helps to ensure that the goals and objectives of the OP are reflected in development and redevelopment. Site plan control provides the opportunity to ensure that OP policies such as 'opportunities for innovative SWM design' are being considered as part of the site design.

Many municipalities have developed site plan control manuals that outline the need for preliminary development meetings to discuss proposed projects, the approval process, and the required elements of the submission. SWM reports are required. There are however, other things the municipality could request to ensure that stormwater is being planned to maximize water quality and quantity controls. Site plan design provides the opportunities to consider and implement innovative SWM design. New developments and redevelopments could integrate

SWM into the landscape. Incorporate drought resistant plant material in order to reduce long term maintenance and conserve water.

Site plans are to be prepared by a qualified planner, Professional Engineer, or landscape architect. For preliminary site reviews that include watercourses and other natural features, it may be beneficial to include staff from the NPCA at the preliminary development meeting.

The proponent should consider creating a map of the proposed site plan that specifically identifies the features of the site that facilitate the natural processing of stormwater. Features such as watercourses, wetlands, existing vegetation, infiltration areas, slopes, swales, and natural depressional areas should be identified. The map would help the engineer, architect or planner to justify site configuration and demonstrate how the natural stormwater processing features have been maintained or enhanced.

Landscape plans should utilize a diversity of native plant species from a pre-selected list (see **Appendix S**). Utilize species that are drought tolerant to reduce watering and future maintenance requirements. Tree survey plans be submitted to identify existing vegetation on site and determine what vegetation can be preserved.

Proponents should be encourage to implement innovative landscape design by considering the natural features of the landscape and ensuring the integration of SWM features, site plan submissions to integrate SWM in parking areas through landscape features, and site plans to demonstrate how the site was configured to isolate impervious areas and infiltrate stormwater where appropriate. The following criteria were developed by the Puget Sound Action Team (2005).

- Reduce front yard setbacks to reduce the length of parking lots;
- Reduced road widths for more compact design;
- Cluster housing units to reduce road widths;
- Loop road designs;
- Discourage dead ends and cul-de-sac streets;
- Consider pull out parking that clusters the parking and creates the opportunity to isolate impervious areas;
- Utilitize stormwater treatment techniques as traffic calming measures;
- Reduce driveway widths;
- Shared driveway parking; and
- Limit impervious areas for driveways to two tracks and the remainder a reinforced grass or other pervious surface.

Municipalities should consider SWM for parking lot expansions or redevelopment to incorporate SWM quality and quantity controls when no controls currently exist. Consider amending site plan agreements to include provisions for stormwater quality and quantity controls.

1.28 Alternative Design Standards

The Town of Caledon applies the following design guidelines when assessing submissions under the alternate development criteria. These alternate development standards are only recognized in the context of Council approved Pilot Projects.

The ‘net gain principle’ successful alternate development design must demonstrate a significantly different, comprehensive and ‘net gain solution’. The engineering solution should have regard for the net overall benefit

of the comprehensive solution. All stakeholders in the alternate design solution should agree with the net gain principle, and the overall values and objectives.

1.27.1 Enhanced Features on Public Lands

The alternate plans may suggest enhancing proposed public infrastructure (*e.g.*, parking lots, recreational lands, sidewalks, and fences). The following guidelines are applied by Town staff when evaluating a proposal:

- The solution must be better than the standard solution, or else equitable trade-offs may be considered;
- All solutions must meet the basic safety, durability, longevity, and functionality criteria. It is understood that there may be more than one way to meet a design objective. Development standards tend to be stipulated for simplicity and rule out alternatives;
- All initial costs to provide enhanced infrastructure should be considered at the expense of the development, as a share in the risk of the project. The Town would assume the risk of replacement issues, unless stated otherwise. The Town will reserve the right to correct problems emerging with respect to specific elements of the infrastructure. The Town reserves the right to apply or preserve the standard design; and
- Enhanced features tend to have higher maintenance and replacement costs. The Town will reserve the right to not to change, maintain or renovate the enhanced features. Accountability for maintenance and upkeep must be determined. Arrangements must be established to address the care and preservation of enhanced features and services, unless otherwise stated by the Town.

1.27.2 Additional Public Infrastructure

Acquisition of parkland beyond the standard 5%, Blocks, Easement and Right of Way will not be compensated by the Town unless otherwise stipulated by the Town. Cash-in-lieu of parkland would be required, where applicable, unless clearly demonstrated alternative advantages are provided. Feature such as access lanes, common areas, linking pathways, and rear-yard features should be assessed for ownership before dedicating these areas for public use.

1.27.3 Irregular Right of Ways

Variant widths for corridor ROW may be considered. Where all servicing requirements are met by infrastructure improvements, corridor widths may vary in pilot projects. Green space along corridors may be within the strategically widened ROW, allowing for flexible lot frontage. Consideration should be given to develop infrastructure which will encourage property owners to maintain curb line, pedestrian corridors, and other publicly utilized areas.

1.27.3 Parking Capacity

Parking on the public ROW is a frequent urban problem. Pilot project need to address this issue with design concerns.

References

Richmond (Town of). 2006. *Sediment Monitoring of Stormwater Management Facilities*. Town of Richmond Hill, Engineering and Public Works Department.

APPENDIX R
Sample Terms of Reference for a Subwatershed Study and Master Drainage Plan

Terms of Reference
for the
[redacted] Subwatershed Studies

January, 2002

PART 1 – OVERVIEW

Issues

The impacts of current and future development and changes in land use within the areas of [redacted] are of concern.

The purpose of this project is to develop a subwatershed plan that allows sustainable development while ensuring maximum benefits to the natural and human environments on a watershed basis. The subwatershed areas of study include the [redacted] Specifically, the following issues with respect to environmental and downstream impacts from development must be addressed.

How can the servicing of existing development and expansion infrastructure of future development take place such that:

1) The aquatic habitat in the creeks within the subwatershed areas are maintained or where possible, enhanced

2) Discharges from proposed land uses to the receiving watercourses do not degrade the existing levels of biological diversity and productivity, nor adversely impact on stream forms

3) Any necessary alteration to the stream systems within the subwatershed incorporates the objectives of achieving natural stable channel form and appropriate habitat characteristics

4) All proposed development is planned and implemented to optimized compatibility with the natural features and their associated functions as well as recreational, cultural resources and features.

5) Groundwater resources and functions are maintained and, if possible, enhanced, including investigation of flow paths and maintenance of these paths where required, considering the aquatic habitat requirements of the stream.

6) The quality of groundwater is not adversely impacted by proposed SWM measures (i.e. infiltration basins) and/or proposed land use. Any proposed servicing does not detrimentally lower the water table or adversely effect the groundwater resources.

7) Stormwater runoff is controlled to ensure that Peak Flow Rates and associated flood levels are not increased as a result of the proposed development.

8) That existing watercourses, of any form, are identified, reviewed in sufficient detail that appropriate polices are established to protect and enhance them.

9) The prolonged discharge from detention facilities does not increase downstream peak flows or channel erosion Stormwater management considerations for quality treatment and protection of stream morphology.

Study Goals and Objectives

The objective of the Subwatershed Plans is to provide an overall strategic framework for resource management within each of the subwatershed areas and the reaches of the various Creeks. The study must provide sufficient detail to support the completion of Secondary Plan Servicing studies. [redacted] (i.e. Secondary Plan level) and any future site specific stormwater and groundwater management plans will implement these strategic objectives in the development of the lands designated for urban use.

The specific goals and objectives of the Subwatershed Plan are:

1) Goal

- To minimize the threat to life and the destruction of property and natural resources from flooding, and preserve (or re-establish, where possible) natural floodplain hydrologic functions.

Objectives

- To ensure that runoff from developing and urbanizing areas is controlled such that it does not increase the frequency and intensity of flooding at the risk of threatening life and property.

- To adopt appropriate land use controls and development standards to prevent development in natural flood hazard and erosion hazard areas

- To ensure that new development incorporates the most appropriate development form and mitigation measures necessary to optimize compatibility with natural features and their associated functions

2) Goal

- To restore, protect, and enhance water quality and associated aquatic resources and water supplies for all forms of water courses..

Objectives

- Protect stream morphological and fluvial character; restore, where appropriate and feasible, sinuosity; maintain physical habitat attributes (pools, riffles etc.), diversity and fluvial processes (bedload transport, energy reduction through sinuosity, etc.); and prevent increase in erosion and deposition, through maintenance of hydrological regime.

- To prevent the accelerated enrichment of streams and contamination of waterways from runoff containing nutrients, pathogenic organisms, organic substances, and heavy metals and toxic substances.

- To maintain or restore a natural vegetative canopy along streams where required to ensure that mid-summer stream temperatures do not exceed tolerance limits of desirable aquatic organisms.

- To minimize the disturbance of the streambed and prevent streambank erosion and, where practical, to restore eroding streambanks to a natural or stable condition.

- To restore, rehabilitate, or enhance water quality and associated resources through the implementation of appropriate Best Management Practices on the land.

- To take full advantage of stream baseflow enhancement opportunities.

- To maintain and enhance the aquatic habitat.

- To minimize disturbance of wetlands, preserving and/or enhancing the habitat and functions they provide.

- Provide appropriate buffers to wetlands, watercourses, and valley lands to maintain or enhance their biological health and meet objectives of long term sustainability of these features.

3) Goal

- To restore, protect, develop and enhance the natural heritage, historic, cultural, recreational, and visual amenities of rural and urban stream corridors.

Objectives

- To ensure that environmental resource constraints are fully considered in establishing land use patterns in the subwatershed.

- To ensure that existing wildlife linkages are preserved and that opportunities for improving these linkages are considered/implemented as part of any future development.

- To retain, preserve or maintain natural heritage features (i.e. open space and visual amenities) in urban and rural areas by establishing and maintaining greenbelts along stream corridors and adjacent natural areas and maintaining linkage between these areas.

- To ensure that development in the stream corridor is consistent with the historical and cultural character of the surroundings and reflects the need to protect visual amenities.

- To ensure that the recreational and fisheries potential of a stream corridor are developed to the fullest extent practicable.

The Study Approach

The Subwatershed Studies will include:

Watershed Synopsis

a. Assessing the existing and potential subwatershed resources (physical, natural, social and economic).

b. Determining the existing and future land uses [redacted] Relating the proposed land use to subwatershed resources.

c. Identifying existing and future problems and opportunities to correct these problems.

Identification of Subwatershed Opportunities and Targets

d. Setting targets to be met and identifying opportunities, which will be developed.

e. Establishment of constraint and opportunity mapping

Watershed Plan Development and Evaluation

f. Developing several scenarios to meet the long term subwatershed goals and objectives.

g. Evaluating the effectiveness of the various subwatershed plans in meeting the subwatershed objectives, targets and enhancement opportunities.

Final Plan Subwatershed Plan

h. Recommending a subwatershed plan and developing implementation strategies and frame work for subsequent studies; example Stormwater and Groundwater Management Plans.

i. Providing for a monitoring and evaluation program to ensure the plan's success and to verify that predicted performance is achieved and to allow for adaptive management response.

Future site specific Stormwater and Groundwater Management Studies completed as part of the Secondary Planning Process will describe in detail

the specific measures which will be undertaken to implement the management objectives and meet the targets and further opportunities defined in the Subwatershed Plan.

PART II – STUDY ORGANIZATION

General

The study will generally follow the process described in the document, "Subwatershed Planning" (MOE, MNR 1993) and must also be consistent with the goals, objectives and targets of the Watershed Plans where they have been completed subject to updating requirements of such plans to meet current guidelines and design criteria.

Relationship to Secondary Planning

It is intended that the Subwatershed Study be completed prior to or in conjunction with the preparation of the Secondary Plans for this area to determine and mitigate any impacts of the proposed development on the natural resources and provide protection against the natural hazards of flooding and erosion. As such, the Subwatershed Study must provide technical support to the secondary plans land use planning process. The Subwatershed study must outline the preferred stormwater and environmental management strategy for the Secondary Plan Area. The Secondary Plan Studies must evaluate in greater detail the implementation of the recommended plan in order to facilitate the land use and infrastructure planning process .

Environmental Assessment Act

The subwatershed planning process may lead to recommendations which include works or undertakings that are subject to the Environmental Assessment Act. The intent of the EA Act is to provide for the protection, conservation and wise management of the environment through planning and informed decision-making. Successful planning under the EA Act consists of five key features:

- consult with all affected parties;
- consider a reasonable range of alternatives to the undertaking and alternative methods of implementation;
- consider all aspects of the environment;
- systematically evaluate the environmental effects of each alternative considered;
- provide clear complete documentation.

The fundamental EA principles shall be incorporated into the subwatershed planning process. The information developed through this planning process should satisfy Phases 1 and 2 of the Municipal Engineers Association (MEA) Class EA requirements. The consultant should review the types of projects that could be anticipated as a result of the subwatershed plan and determine what specific Class EA requirements will need to be incorporated in the plan. The steps are as follows: evaluate alternatives to projects; select preferred options; and incorporate documentation of Class EA requirements into the subwatershed plan

Canadian Environmental Assessment Act (CEAA)

The preferred management strategies, will also need to be consistent with the requirements of the Federal Fisheries Act and the "no net loss" policy. It is intended that the subwatershed plan will provide general criteria for construction activities, facilities and structures which will impact, or could, potentially impact, upon fish habitat. Notwithstanding, the direction outlined within this plan, final design plans may still require approval by the various regulating agencies, however the adherence to the design criteria outlined herein will facilitate both planning and design, as well as ultimate agency review.

Public Participation

a) In order to obtain public input on the formation and evaluation of various water management plans, the consultant will hold three Public Meetings during the course of the study, as follows.

i) - Notification of the study.
- Review of subwatershed Goals and Objectives, work program.
- To be held during the Background Report review period.

ii) - Review of management Objectives and Plan alternatives and review of background data collection
- To be held during the Characterization Report review period.

iii) - Review of evaluated alternatives and preferred Plan.
- To be held during the Draft Final Report review period.

The public meetings will take the form of an Open House and a Public meeting.

Technical Advisory Committee

The TAC will be chaired by [redacted] have the following representation:

- [redacted] 4, includes Chairperson
- [redacted] 3
- [redacted] – 3
- Stakeholder Advisory Committee – 2
- Landowners - 2 .

The TAC meetings will be made available to the general public for attendance purposes.

Geographic Information Systems

It is expected that data and mapping will be organized and developed with the use of GIS. ARC/INFO is preferred for mapping and figures. All files are to be prepared in "DXF" format, or as specified by the [redacted] Manager of GIS Services. All digital information, data, sketches, drawings and reports generated by the consultant for the purpose of this study shall become the property of the [redacted] All new data being incorporated into the GIS shall be at a scale of 1:10,000 or larger.

Reports

a) After carrying out the background review, the Consultant will prepare a ***Background Report*** *which will cover all data sources of information.*

b) After carrying out the initial inventories and assessment, the Consultant will prepare a ***Characterization Report***. This report will contain but not be limited to:

- watershed hydrogeology report
- watershed hydrology (existing)
- floodplain mapping
- existing and future land use
- flood and erosion problems
- natural heritage features identification and evaluation
- fishery inventory and fish habitat assessment

- water quality evaluation
- summary of applicable Provincial and Municipal policies that will aid in achieving subwatershed goals and objectives
- list of alternatives/measures that are considered to mitigate potential adverse impacts

c) After carrying out the Characterization Report the Consultant will prepare an ***Interim Report.*** This report will detail the following:

- Impact of future development (Water Quality and Quantity – flooding and erosion)
- Development of alternate mitigation measures
- Detailed evaluation of the various mitigation measures
- Preliminary Recommendations for preferred management measures
- diskettes of model input/output

d) The Consultant will prepare and distribute the Final Report. The ***Final Report*** will consist of:

- the General Report which describes the final Subwatershed Plan and Implementation and Monitoring Strategy
- the Technical Report which documents the study findings and describes in detail the Plan and Implementation and Monitoring components
- Technical Appendix Reports documenting each of the detailed Inventory and Assessment Studies.
- One digital copy of all GIS mapping collected or developed in the preparation of the subwatershed plan (.e00 or shape file format (ARC/INFO, ArcView))
- All documents and supporting data collection, analysis and models to be supplied to [redacted] n digital format
- Licensed copies of the Hydrologic and Hydraulic models including all input/output data to be supplied to the [redacted]

e) Report Distribution

- One copy of each interim report will be prepared for each member of the Advisory Team.

Copies of the Final Report will be distributed as follows:

- fifteen copies each of the General Report and Technical Report.

Meetings

The Consultant will allow for at least six Project Team meetings and three formal presentations:

- start up
- presentation of work plan
- presentation of the background review, including a walking tour of the study area
- evaluation of the plan alternatives
- presentation of the Characterization Report
- presentation of the Interim Report
- presentation of the plan alternatives
- presentation of Final Report
- final report presentation to the Subwatershed Study Team
- final report presentation to municipal council

Summary of Study Components

Each component is summarized in two parts. The first portion of the summary deals with the background review and assessment work. The second portion deals with the scenario testing and formulation of the final plan.

Hydrology

A detailed hydrologic model should be developed and calibrated for the sub-watershed for the existing, and future development scenario. The model should be a continuous, deterministic, hydrologic model, approved by the Technical Advisory Committee, with strong physical representation of surface runoff, base flows, and surface groundwater interaction. At the completion of the study the consultant will be required to supply the [redacted] with a licensed version of the hydrologic model, including program documentation, along with all digital input files, if required.

The subwatershed physical feature mapping such as subwatershed boundary, watercourses, drainage swales and wetland features should be verified, and sub basins determined to establish nodes at points of interest. The intent of the modeling is to provided the details required for subdivision planning. The model should be calibrated to provide comparable flows at the sub basin outlet to those determined in the previous watershed studies. The model input parameters should be compared to the previous watershed

studies and modified to represent the more detailed subwatershed model. Calibration of the hydrologic model should be based on both specific storm events, and low flow measurements. Model calibration will have to be completed to the satisfaction of the Technical Advisory Committee.

Revise hydrology to reflect future development condition scenarios. Investigate the impact of post development flows and volumes on flood levels, stream erosion and base flows. Optimize scenarios to reduce adverse affects, incorporate water conservation techniques and develop enhancement opportunities.

Undertake an erosion potential analysis based on the erosion data collected to understand the erosion processes that are occurring, identify areas which are highly prone to erosion or where structures may be at risk, and determine the threshold flows for erosion at strategic points in the subwatershed.

Flood Plain Management

Update the flood hydrology for the future condition. Where necessary update existing floodlines using updated future flow rates. Identify areas subject to flood damage and the consequences of flooding. Identify erosion susceptible areas. Identify flow and volume constraints. Determine base flows and drought characteristics of stream discharge. Floodplain mapping for all areas of future development will be required.

It will be necessary to develop flood lines for all watercourses not currently included in the existing flood plain mapping which are located in any areas where future development will occur, where the upstream drainage areas are greater than ½ half square mile (125 ha). This analysis should be completed in accordance with the standards set out in the FDRP program based on the flows resulting from the ultimate development scenario. The U.S. Army Corps of Engineers HEC II back water model or HEC RAS model is acceptable for the hydraulic analysis. For tributaries which have drainage areas less than ½ square mile (125 ha) floodplain mapping may not be required, however alternate methods to ensure adequate hydraulic capacity may be required.

Hydrogeology

The goals of the subwatershed study with respect to hydrogeology include the following components.

Conceptual Model

To establish a geological conceptual model for the subwatershed, determining the key characteristics of the bedrock and overburden systems and their function in terms of controlling groundwater movement, availability, and quality in the subwatershed. An integral component is to assess the interaction between the groundwater system and the surface water system and to determine the overall role or function of this interaction in an ecosystem context.

Mapping

Map regional groundwater flows and quality in the subwatershed. Identify existing recharge-discharge zones to maintain/enhance baseflow and instream water temperature. Identify suitable sites for urban stormwater infiltration to avoid contamination of the groundwater table. Identify areas of potential recharge to the regional groundwater aquifer. Determine potential groundwater storage available. Determine the groundwater contribution to maintaining the existing natural areas (wetlands, environmentally sensitive areas, etc.).

Protection and Mitigation Measures

Determine the impact of wells and other development on groundwater levels. Generate development scenarios that incorporate infiltration opportunities and water conservation techniques to enhance or maintain groundwater levels and quality.

Water Quality

Assess the existing water quality of the reaches of the various creeks. Note existing sources of pollution and recommend remedial action. Investigate the impact of existing urban development. Identify opportunities for water quality enhancement, where possible.

Recommend water quality objectives based on stream use: aesthetics, fishery. Prescribe practices and techniques to maintain/enhance, where possible the water quality. Assess development scenarios against water quality objectives. Establish a water quality monitoring program to monitor progress.

Stream Morphology

One of the objectives is to protect stream morphological and fluvial character; restore, where appropriate and feasible, sinuosity; maintain physical habitat attributes (pools, riffles etc.), diversity and fluvial processes (bedload transport, energy reduction through sinuosity, etc.); and prevent increase in erosion and deposition, through maintenance of hydrological regime.

Characterize each reach of the subwatershed using the Rosgen classification system and, based on the morphological attributes of each channel reach, determine the physical and biological health of the watercourses.

This study component would also include provision of recommendations relating to watercourse system attributes to provide guidance for open space blocks and design guidance for the stream rehabilitation opportunities.

Fish and Aquatic Habitats

Initial assessment work would include existing habitat assessment, spawning survey, benthic inventory and fisheries inventory. Identification of stream baseflow sources and investigation of opportunities for baseflow and habitat enhancement. Identify current sources of degradation. The consultant would work closely with [redacted] and the Ministry of Natural Resources when carrying out this assessment work.

Set targets to ensure maintenance or enhancement, where possible, of stream baseflow and temperatures. Recommend practices and techniques to achieve or exceed targets. Applying recommended practices and techniques, investigate the impact of proposed urban development scenarios.

Natural Heritage Areas

Identify the wetlands, wood lots, wildlife travel corridors and wildlife habitat areas. Identify the relationships between the wildlife and the natural areas. Identify the resource management role of the existing wetlands and woodlots in flood attenuation, wildlife habitat, water quality enhancement. Confirm boundaries of natural heritage areas.

Review previous evaluation methodologies and provide recommendations for appropriate evaluation methodologies for use in the subwatershed study as necessary.

Set detailed technical objectives, targets to be met by proposed development. Specify the best management practices that should be considered to meet these targets. The function served by the natural areas should be protected or enhanced, where possible, by the proposed management practices.

Investigate the impact of urban development. Recommend practices and techniques to mitigate development impacts and restore the natural ecosystem.

Relationships Between Study Components

Define relationships between study area components required for the description of the overall subwatershed system.

Assess the impacts of different plans on these relationships.

Land-Water Management

Determine existing and future land use, [redacted] Relate proposed land use to subwatershed resources. Identify isolated resource areas and opportunities to link isolated areas to main corridors.

Comment on land use scenarios that will meet future land use needs and minimize impacts on the environment, particularly the environment along the stream corridors.

Implementation and Monitoring Plan

Recommend an implementation strategy, including phasing, cost sharing, pubic awareness program development, public land acquisition, enforcement and updating. Recommend a monitoring program to measure the plan's success.

Part III – Tasks To Be Carried Out

The work to be carried out for each major study component is described in detail in the following section.

1. Background Review

Engineering

- existing and future servicing corridors

The background review will include all relative reports and information sources.

b) The consultant will layout a frame work for the organization, management and presentation of resource data.

c) The consultant will identify all wetlands, ponds, drainage paths, and defined watercourses using aerial photos and field inspections. During the field inspections, the Consultant will also observe and comment on existing land uses, vegetative cover, quantity of flow, wildlife and fish habitat and pollution sources.

d) Data deficiencies should be identified and requirements for field monitoring of specific parameters or characteristics to augment the data base should be made. Standards will have to be specified for collection of additional data. Additional field data shall be collected where necessary and added to the existing databases such that the level of detail will support the decision making process of the subwatershed study.

e) Consideration should be given to post development monitoring requirements when sighting locations of additional stations. Additional data requirements identified by field survey.

f) The consultant will prepare a base map of the study area which can be used throughout the study to overlay subwatershed attributes and plan components.

g) After carrying out the review, the Consultant will prepare a background report which will:

- summarize the findings of the review;
-formulate an issue and problem statement;
-prepare a detailed work plan for the study.

The background report should be prepared in such a way that it can be used as introductory chapters in the final study report (see Schedule A).

h) the consultant will work closely with the Technical Advisory Committee chairman and members of other on-going studies.

storms along with several historical events including the Regional Event.

d) It is required that an appropriate hydrologic watershed model be used for all subwatershed areas. The model should be a continuous, deterministic, hydrologic model, approved by the Technical Steering Committee, with strong physical representation of surface runoff, base flows, and surface groundwater interaction The Consultant is to ensure the model accounts for the following processes:

- soil infiltration
- soil moisture
- channel storage
- full seasonal effects (snow accumulation and melt)

e) The watershed model of the existing condition will be verified with available flow records and high water marks and streamflow/rainfall data collected during the study.

f) The results of the predevelopment modeling will be used to set targets for outflow control rates which will be provided and return period flow rates at key locations and are all weighted flow rates for smaller development areas.

g) The Consultant will assess the impact of development on stream peak flows, cumulative excess shear and flow duration.

In addition to these initial scenarios, the Consultant must be prepared as part of the testing of alternative plans, to test the sensitivity of flows and volumes to variations in land use density and best management practices.

h) Flood plain mapping will be extended where necessary and existing floodlines within the subwatershed revised using updated future flow rates. Floodplain mapping for all area of future development will be required. It will be necessary to develop flood lines for all watercourses not currently included in the existing flood plain mapping which are located in any areas where future development will occur, where the upstream drainage areas are greater than ½ half square mile (125 ha). This analysis should be completed in accordance with the standards set out in the FDRP program based on the flows resulting from the ultimate development scenario. The U.S. Army Corps of Engineers HEC II back water model or HEC RAS model is acceptable for the hydraulic analysis. For tributaries which have drainage areas less than ½ square mile (125 ha) floodplain mapping may not be required, however alternate methods to ensure adequate hydraulic capacity may be required.

Erosion

a) The Consultant will identify, by field inspection, sites where bank erosion is taking place or could potentially occur.

b) The Consultant will estimate erosive velocities and identify, using the hydraulic study results, sites that may be subject to erosion under existing and post-development conditions and will undertake a flow duration exceedance analysis based on existing, future and ultimate conditions.

c) The Consultant will identify flow constraints, which may avoid or reduce future bank and bed erosion problems.

Hydrogeology

The purpose of this assessment is to:

a) determine the groundwater contribution to baseflow and to the natural systems (wetlands, etc.);

b) determine the quality of groundwater resources;

c) determine the change in groundwater quantity and quality;

d) determine the impact on groundwater levels of municipal or private wells;

e) determine how to protect groundwater quality from degradation by surface activities or artificial recharge;

f) determine recharge and discharge areas;

g) identify those recharge sites which are suitable for urban stormwater infiltration (i.e. avoid contamination of regional groundwater table);

h) identify areas suitable for recharge to the regional groundwater table;

i) determine the storage available in the groundwater aquifer.

In order to meet these objectives, the consultant will:

j) review and assess all available information on the hydrogeology of the area

k) using existing information, prepare geologic mapping of the aquifer system together with appropriate cross-sections;

l) outline data deficiencies and estimate the cost of additional drilling and sampling required to remedy these deficiencies;

m) prepare hydrogeologic mapping including aquifer distribution, recharge and discharge areas, potentiometric surfaces, flow directions, cross-sections, existing problem areas and permit holders;

n) calculate water budget and aquifer characteristics;

o) in conjunction with the findings from the Hydrology section, determine the groundwater contribution to maintaining baseflow and to maintaining the natural systems (wetlands, etc.);

p) set targets for infiltration runoff to maintain or enhance baseflows.

q) sample and describe groundwater quality in the aquifer system;

r) determine the effect of existing and proposed municipal wells on ground water and surface water quality, quantity and stream baseflow;

s) determine what areas are susceptible to ground water contamination and recommend what land use or management practices should be apply to these areas;

t) identify opportunities for urban stormwater infiltration (avoid contamination of regional ground water table);

u) Recommend a long term monitoring program to evaluate the effectiveness of the plan recommendation and allow for adaptive management response.

Stream Morphology

Characterize each reach of the subwatershed using the Rosgen classification system and, based on the morphological attributes of each channel reach, determine the physical and biological health of the watercourses as well as providing guidance for necessary spatial considerations for the stream and rehabilitation opportunities.

Recommend a long term monitoring program to evaluate the effectiveness of the plan recommendation and allow for adaptive management response.

Water Quality Assessment and Monitoring

The water quality monitoring and assessment tasks associated with this study include:

a) assessment of the existing stream water quality and setting realistic long term objectives compatible with stream use: aesthetics, and targeted fish habitat;

b) recommend appropriate volumetric requirements and other design criteria for stormwater management facilities (i.e. source and end-of pipe - as appropriate);

c) identify pollution sources, loading and source control measures, both short term and long term for urban and rural areas;

d) recommend a long term water quality monitoring program to measure the plan's success, verify performance and allow for adaptive management response;

e) evaluate the impact of the subwatershed reservoirs or ponds have upon the stream water quality and temperature. Where necessary, recommend remedial measures.

Natural Heritage Assessment (Environmentally Sensitive Policy Areas, Wetlands of Provincial Significance, Regulated Areas, Watercourses)

The Consultant will:

a) Review previous studies on the natural heritage areas.

b) Identify wetlands, woodlots, wildlife corridors and wildlife habitat areas.

c) Define relationships between wildlife and natural areas.

d) Where necessary, inventory the vegetative and wildlife resources of each area, confirm previous findings;

e) In conjunction with the Hydrology and Hydrogeology section, determine the water needs of these natural systems and appropriate buffers.

f) Identify the circumstances, which promote the observed resources. Set targets and recommend practices to ensure their maintenance or enhancement, where possible.

g) Investigate the impact of the existing and proposed land use changes, municipal wells, and servicing are having and will have on these natural areas. Suggest practices and techniques to maintain the natural resources.

h) Investigate opportunities to restore and enhance natural heritage areas in strategic locations.

i) Identify opportunities to link isolated natural areas to the main corridors.

Fishery Inventory and Fish Habitat Assessment

Upon consultation with the [redacted] Ministry of Natural Resources, the consultant will compile existing fisheries data and carry out the following additional studies.

a) Fish habitat assessment of the main channel and all tributaries in accordance with the appropriate standards.
b) Any necessary spawning surveys as determined based on the background review and initial fieldwork.
c) Benthic inventory at representative stations. Compile a list of aquatic invertebrates present at time of sampling. Usually collected by surber sampler, seine net and dip net.
d) Fisheries inventory at representatives stations. List of fish species present at the time of sampling.
e) Identify existing habitat features which are critical for maintenance of the existing fishery using information obtained in a).
f) Identify existing habitat features which may be presently limiting fish production (e.g. Elevated temperatures, sedimentation).
g) Using the information obtained, suggest opportunities from enhancement of fish production as development proceeds. (e.g. infiltration of stormwater, removal of onstream ponds or structures, placement of spawning gravel over upwelling areas)
h) Examine fisheries problems and opportunities created under a variety of subwatershed development scenarios.
i) Through interaction with other disciplines develop a preferred approach which documents habitat maintenance/enhancements.

3. *Formation and Evaluation of Subwatershed Management Plans*

Watershed Synopsis

a) The consultant will summarize the targets, constraints and opportunities identified in the subwatershed Synopsis:

- land use targets and constraints
- recreation targets and constraints
- flood flow and volume constraints for flood and erosion control

- constraints on urban development to meet flows and volume targets
- susceptibility of groundwater to contamination from urban stormwater infiltration
- potential recharge and discharge zones to maintain/enhance baseflow and water temperature in the stream
- existing sources of pollution and corresponding remedial action
- water quality targets based on stream use
- constraints on urban development to maintain/enhance water quality
- circumstances which promote the target fish species
- constraints on urban development to enhance fish habitat
- natural heritage areas (wetlands, environmentally sensitive areas, stream corridors, regulated areas)

Watershed Targets and Opportunities

b) The Consultant will consolidate the list of targets and constraints to fulfill the subwatershed Goals and Objectives.

Plan Development

c) using constraint analysis, develop a stream corridor management boundary for the streams within the subwatersheds. The stream corridor should be determined so as to include natural, cultural and historic features where protection and preservation is important to meet the goals and objectives of the study. Features to be included are floodplains, wetlands, erosion prone areas, significant wildlife areas, ecologically important areas and stream or waterway related recreational areas.

d) The Consultant will prepare a list of Conservation Practices, based on applicable Federal, Provincial, Watershed and Municipal policies, guidelines, and objectives, which address stream flow, water quality, wetlands, fisheries, soil erosion and general resource conservation requirements. (This list is intended to be used as a guide and starting point in formulating alternative plan components).

e) The Consultant will investigate alternative measures and techniques to address targets and constraints for flooding, erosion, water quality, natural resources and fish habitat under present and future conditions. These measures may include:

- the identified conservation practices and variations on them
- programs and works to address existing problems
- considerations for type, density, and location of development
- works to be incorporated during individual site development

- centralized works to be implemented prior to development;

f) The Consultant will combine various measures and techniques to formulate alternative plans which will meet the Subwatershed Plan Goals and Objectives.

Final Subwatershed Plan

g) the Consultant will evaluate and compare each of the plans. The evaluation will be based upon:

a) how well the Study's goals and objectives are met;
b) environmental impacts of each plan (physical, natural and social).

h) Review and analyze applicable Provincial, Regional and Municipal plans and policies to ensure that any recommended subwatershed management plans are consistent with the existing plans and policies.

i) Recommend a preferred plan.

4. Implementation Plan

The Consultant will recommend an implementation strategy for the plan which will ensure that the Management Objectives will be met. The implementation strategy will include but not be limited to:

- phasing of required works
- public awareness program
- reflecting the appropriate implementations and directions in Secondary Plans, Zoning By-laws and Draft Plans
- directions to development proponents on site-specific studies and assessments
- available plan review mechanisms such as conditions of subdivision draft plan approval, site plan control
- enforcement measures such as Zoning, Fill Regulations, Site Plan Agreements and corresponding responsibilities for inspection
- enhancement programs
- timing and responsibilities for further study
- recommend additional plans and studies (e.g. Secondary Plan Level Studies) and Terms of Reference thereof

5. Monitoring

a) The Consultant will recommend a monitoring program to evaluate the effectiveness of the plan recommendation and allow for adaptive management response, The monitoring will include:

- short and long term station network for streamflow, groundwater, water quality, fish and benthic surveys, as well as stream form, and natural heritage features.
- monitoring and reporting responsibilities, short term and long term
- sources of long term funding
- follow-up and enforcement responsibilities tied in with implementation strategy
- monitoring of fish habitat features

6. *Project Timing*

The Background Report is anticipated to be completed approximately 2 months following the study commencement.

The timing of the Subsequent Reports will be subject to, status of data collection (i.e. rainfall and streamflow), status of the available background data and need to undertake field work assessments.

1 DEFINITIONS/ACRONYMS:

"environment" is defined as per the Environmental Assessment Act.

[redacted]

"model" is defined as a software package used in the assessment of existing and future conditions.

"page" is defined as an 8.5" by 11" sheet of paper. The only exceptions to this will be the project schedule and/or budget, which may be submitted on 11" by 17" paper.

2 GENERAL

2.1 PURPOSE AND OBJECTIVES

[redacted] embarking on a number of master planning initiatives to provide guidance for stormwater management (SWM) planning over the next 30 years.

The purpose of this assignment is to develop a Master Drainage Plan [redacted] to address:

- appropriate methods of accommodating the pre and post development storm water discharge and water quality control from lands located within the [redacted]
- appropriate methods of accommodating the pre and post development storm water discharge and water quality control from lands located within the [redacted]
- appropriate storm water management control strategy; and
- preliminary design and location feasibility of any storm water management facilities and major storm drainage infrastructure identified in this study.

[redacted]

2.2 BACKGROUND

3 SCOPE OF SERVICES

The consultant will be responsible for all the work associated with the successful completion of this Study, including technical analysis, environmental assessment and public consultation. [redacted] will review the work as it proceeds, answer questions regarding policy and liase with elected officials.

Regarding public consultation, the consultant should be aware that [redacted] exceeds the minimum requirements set out by the Ministry of the Environment, as warranted. Discretionary Public Information Centres and other consultation events, as specified in this RFP, are generally required by [redacted] web site will also be used as part of the public consultation component.

This Study will address Phases 1 and 2 of the Municipal Class Environmental Assessment process, in accordance with the established principles for Master Planning. The final report will be posted on the project web site for public information and will be filed with MOE for an official 30-day public review period. Council endorsement of the final report will be requested.

The final public notice for the Study will be the "Notice of Completion" for the Schedule B projects identified in the Study. The "Notice of Completion" shall be submitted to the review agencies and the public. A review period of least 30 calendar days shall be allowed for comment and input. The "Notice of Completion" shall include notification of the provision to request a Part II Order. It is understood that any

requests for an order to comply with Part II of the EA Act can only apply to the specific Schedule B projects identified in the Study and not the Study itself. It will not be within the scope of services of the consultant to deal with concerns resulting from an order by the Minister requiring [redacted] to comply with Part II of the EA Act.

The Consultant will be responsible for addressing, to the satisfaction of [redacted] any comments received from the review agencies or the public during the 30 day review period. Upon addressing the comments to the satisfaction of [redacted] Council's endorsement of the final report will be requested by Staff.

This Master Drainage Plan will consider current land use and planned land use scenarios over the next 30 years. It will provide a basis for longer term planning by the [redacted] This Master Drainage Plan will identify problems and/or opportunities and investigate alternative solutions.

4 KEY PERSONNEL - QUALIFICATIONS AND EXPERIENCE

The consultant shall provide a project team organization exhibit detailing the key staff and subconsultant staff responsible for the various areas of work. Also please describe who will be directly responsible for project management and/or day-to-day direction of the assignment.

5 WORK PLAN/STUDY ACTIVITIES

For each major task, describe the rationale/objectives, input requirements, methodology/tasks and deliverables within your proposal.

5.1 CHANGES IN SCOPE

All scope changes must be approved by the [redacted] Project Manager. Approval is required prior to proceeding with any work that the consultant believes is beyond the original scope.

5.2 EA PROCESS

Typically the EA Master Planning Process encompasses Phases 1 and 2. Phases 3 and 4 may be included where approval for Schedule B and/or Schedule C projects is sought. For the purposes of this proposal submission, the consultant should assume that Phases 1 to 2 are required and that approval for Schedule B projects is required.

5.3 DATA COLLECTION AND REVIEW

Background information on the study area is to be collected from all available sources including, but not restricted to, the previous watershed floodplain mapping, existing drainage plans and reports in [redacted] files and the latest [redacted] topographic and photo base maps.

The [redacted] will make available the following:

- [redacted] bench marks;
- Drainage reports, plans and other design data for the study;
- Plan and profile drawings of the storm sewer system(s);
- Existing digital topographic mapping of the study area;

- Existing information regarding natural heritage systems, hydrogeology, fluvial geomorphology, fisheries and benthics;
- [redacted] specifications for digital topographic mapping; and
- Detail sheet surround (standard drawing form), [redacted]ogo, legend, etc.

The list of previous/relevant studies and data available for the Consultant include:

- Regional and Local Official Plans
- Studies and other resources listed in Section 2.2 - Background;
- [redacted]
- [redacted]

Documents such as [redacted] will also be relevant to this study.

[redacted] will provide existing land use and community features. The existing land use and future land use planning information used in developing the Master Drainage Plan is to be documented by the consultant. The Community Planning and Design Section of the Planning and Economic Development Department will be consulted for information related to the archaeological and heritage resources mentioned earlier in this document.

The consultant will be responsible for identifying any data gaps and obtaining the necessary data to complete this assignment.

5.4 STAGE I - ANALYSIS OF EXISTING CONDITIONS

The consultant will carry out an analysis of existing conditions to evaluate existing drainage conditions, and to identify drainage deficiencies and stormwater management (SWM) requirements. This analysis will be based upon existing data and analysis, updated by the consultant to reflect current conditions and analysis requirements.

The analysis should:

- Identify existing minor and major drainage systems;
- Develop modelling data files, as necessary, to develop design flows for all storm events (2, 10, 25, 50, 100 year, Regional);
- Assess current drainage systems and outlets to identify drainage constraints and/or capacity restrictions. Run the model as required for this analysis;
- Assess existing natural heritage features and habitat features, as required;
- Analyse potential impacts of changes in land use as necessary. Analyse potential hydrologic and hydraulic impacts and associated drainage and SWM needs;
- Review current watershed plans and identify any additional criteria for water quality control, base flow targets, infiltration targets, erosion control or volume control targets;
- Carry out consultation with the City, Conservation Authorities and other relevant agencies to finalize approach and targets and to discuss issues;
- Through analysis and agency consultation, identify targets to be met for drainage and SWM including:
  - Peak flow control;

- Volume control;
- Base flow/extended detention;
- Infiltration;

- Develop a clear Statement of Problems and Opportunities.

The consultant is also responsible for collecting any data required to calibrate the model.

5.5 Stage II - Develop and Evaluate Options

The consultant will develop viable options for drainage and SWM to address identified problems. In addition, the consultant will develop a process for the evaluation of options to meet the EA process that includes, but is not limited to, the following factors:

- Effectiveness of storm water management options;
- Social/community impacts;
- Natural Environmental impacts;
- Cost (life cycle).

Environmental factors to be considered during the evaluation will be identified during Stage I of the study by the consultant and will be reviewed and confirmed with the [redacted] Project Team.

The consultant will consult with the Project Team to review and refine the evaluation process. He/she will then carry out the evaluation of options and identify the preferred option. A description will be prepared, including discussion of how the preferred option will impact on the current Official Plan and/or Secondary Plan.

5.6 Stage III and IV – Storm Drainage and Facility Preliminary Design

For the preferred option, the consultant will:

- analyse all drainage outlets for future development areas for post development capacity (in accordance with [redacted] Design Standards);
- detail an appropriate storm water management quantity control strategy;
- provide preliminary storm sewer layouts (where appropriate);
- identify major and minor drainage systems;
- provide preliminary design of the storm water management facilities, in accordance with the Ministry of Environment's Storm Water Management Practices Planning and Design Manual (2003). These guidelines could be exceeded if warranted by the Study); and
- provide a phasing/implementation plan that outlines the order in which the identified storm water management facilities and/or storm drainage infrastructure need to be constructed, as well as the steps to be taken to implement the Master Plan between completion of the Master Plan and the construction of the storm water management facilities. Beyond developing the implementation plan, the work listed in that plan is not included in the scope of the Master Drainage Plan [redacted]

The principle of dealing with drainage (quantity and quality) on a watershed basis must be incorporated into the work program.

Overall Master Drainage Plan

The consultant is to prepare a Master Drainage Plan for the Study Area illustrating and describing all existing drainage areas and drainage features including drainage paths, watercourses, storm sewers (existing and proposed) and storm water management facilities. Data deficiencies will be identified and field inspected by the consultant, if necessary. The drainage plan is to conform to [redacted] CAD standards.

The final Master Drainage Report will reflect the proposed Master Plan.

5.7 FINAL REPORT PREPARATION

The consultant will provide a report including all above stages. It is anticipated that the interim documents prepared for during the study will become chapters of the final report. At the end of the study, it is intended that the Master Drainage Plan will be approved by the [redacted] Conservation Authorities.

[redacted] staff will also be responsible for obtaining Council endorsement and filing of the document with MOE. The [redacted] will prepare any newspaper notices and notice letters to agencies regarding the completion of the Master Drainage Plan and Report. Placement of the newspaper notice will be the [redacted] responsibility.

5.8 PUBLIC PARTICIPATION

Public participation shall be encouraged through several initiatives:

- Invitational Focus Group Workshops;
- Public Information Centres; and
- Project Web Site.

Focus Group Workshops:
Focus Group Workshops are small group discussions for the exploration of ideas. The purpose is to generate and develop ideas and solutions that consider the perspectives of a range of stakeholder groups. These allow for a more detailed discussion of issues than commonly possible at Public Information Centres and are particularly beneficial for contentious issues and for exploring reaction to new ideas. Invitational workshops are held to ensure that known interests are in attendance.

The consultant shall prepare for and run 2 invitational Focus Group workshops. The Focus Groups shall be held in advance of the PIC's unless otherwise agreed with the [redacted] The first workshop could include a discussion of existing and future conditions, data gaps, and next steps. The second workshop could concentrate on strategies for stormwater management, implementation and monitoring.

Invitees to these workshops could include agencies such as the [redacted] Conservation Authority, the Ministry of Natural Resources, the Department of Fisheries and Oceans, [redacted] area landowners, [redacted] staff and naturalist groups.

Public Information Centres:
Public Information Centres are held to disseminate/receive information on the study involving a large number of interested people, using an informal process. They allow for one-on-one discussions between members of the Project Team and members of the public. They usually involve informative displays and

may include handouts and/or a public meeting component with a presentation and question and answer session.

The consultant shall allow for two PIC's. The PIC's will be an Open House format and will run from 6 p.m. to 8 p.m. The consultant will be responsible for preparing any display materials that the consultant, in consultation with the [redacted] Project Manager, deems appropriate. The [redacted] will be responsible for printing display materials, comment sheets and sign-in sheets. The consultant must ensure that all PIC materials are provided to the [redacted] for review and printing 10 days in advance of the PIC.

Presentations:
The purpose of special presentations is to inform and engage specific stakeholder groups in the study process. Presentations to Council through the Public Works, Infrastructure and Environment Committee are required in advance of each series of PIC's. The consultant shall include one presentation to Council through the Public Works, Infrastructure and Environment Committee during the Master Planning process.

Project Web Site:
The purpose of the project web site is to provide an outreach tool to facilitate input from those in the community who are unable or unwilling to attend public events. It also assists in the dissemination of reports and documents without the cost of reproductions and allows for frequent update of study materials.

The project web site will be developed and maintained by [redacted] staff. The consultant will provide input to the web site as required. This input shall include descriptions of upcoming events, published notices and background information. Presentation materials from PIC's and final reports will also be provided in Adobe Acrobat (.pdf) format for posting on the web site.

NOTE: The consultant shall be responsible for ensuring that all documents for public consultation events, including, but not limited to, PIC material, presentations, minutes of meetings, etc., shall be agreed to and signed off by the [redacted] project manager 48 hours before the public release of the documents.

5.9 Recommendations/Implementation Plan

The Master Drainage Plan will develop recommendations for addressing short, medium and long term needs and opportunities, with consideration for the financial capability of the [redacted] The Plan will identify a logical implementation plan/staging plan and will recommend which improvements are consider growth related and should be financed as part of development charges. A comprehensive summary of scenarios examined and the assumptions associated with each must be produced.

The Master Plan must also recommend reasonable methods to monitor the performance of the storm water management system with regard for the [redacted] established targets and vision.

The consultant will identify in the Master Plan the Municipal Class EA Schedule of projects (Schedule A, B, or C).

The consultant will identify in the Master Plan those projects that can be considered growth-related and the portion of costs attributable to growth and to existing development.

5.10 REPORTING REQUIREMENTS

The following interim deliverables (as a minimum) shall be submitted in draft and final form:

- Technical Memorandum on Data Collection and Review (list of assumptions and data support for the Master Planning work);
- Summary of Public Participation Program;
- Presentations/Agendas/Minutes for all meetings (Project Team, Focus Groups, Regulatory Agency, Advisory Committee, stakeholders); and
- Comprehensive summary of scenarios examined and the assumptions associated with each.

The following final deliverables shall be submitted in draft and final form:

- Master Plan Report; and
- Project File.

An outline (Table of Contents) is to be prepared by the Consultant and approved by the [redacted] in advance of the preparation of the draft Master Plan Report and Project File. Content from the interim deliverables may be assembled, as appropriate and compiled into the overall report. The consultant will allow one month for the review of each of the draft and final reports by the [redacted]

The draft and final reports shall have an executive summary intended for a general audience.

The draft and final reports will be submitted in hard copy and electronic formats (MS Word file as well as a pdf file suitable for posting on the web site and for printing additional copies of the report). 8 bound copies of the draft report and 5 copies of the final report will be submitted to the [redacted] following approval. The [redacted] will be responsible for printing any additional copies required.

6 SOFTWARE REQUIREMENTS

The consultant must have a working knowledge of drainage/stormwater software packages such as Miduss98, Visual Otthymo, Hec-2, SWMM, etc. The consultant must own the appropriate software licenses for the programs proposed for use during this assignment. The [redacted] will supply its existing modelling data files, where they exist. Any changes that the consultant makes to the modelling data files during this assignment must be documented, including the reasons for the changes.

The [redacted] standard CAD program is Bentley Microstation. Mapping must be compatible with this system and incorporated into the City's GIS. The standard GIS is Integraph Geomedia and Geomedia Pro. If the consultant does not use Microstation, it is his/her responsibility to ensure that the mapping is converted to Microstation format. Other preferred capabilities include: Mr. Sid for aerial photography; utilization of an ftp side for data transfer.

The [redacted] principal software is Microsoft Office. Other graphic software used includes Photoshop, Corel Draw and Page Maker. Written reports must be in Microsoft Word format as well as Adobe Acrobat (.pdf) format. The project schedule must be readable in MS Project 2000.

In regards to projects that involve sharing [redacted] owned or third party information (i.e. aerial photos, databases, CAD files, etc.) with consultants, a data licensing agreement must be completed.

7 STUDY SCHEDULE

The study schedule will be submitted in MS Project format, readable by version 2000. The schedule will be updated on a monthly basis to show project progress and submitted to the [redacted] with the consultant's monthly status report.

The final completion of the Study is required by the end of December 2006. In order to achieve this completion date, the following interim deliverable dates are proposed. The consultant may propose other dates in his/her proposal to reflect his/her understanding of the project.

The consultant shall allow a minimum of 3 weeks for the review of draft interim deliverables and 3 weeks for the review and acceptance of final interim deliverables. The consultant shall allow a minimum of 4 weeks for the review of the draft and final Study Report. Interim and final deliverables must be accepted by the [redacted] prior to presentation to [redacted]

Milestone:	Date:
Award of Contract	September 2005
Finalization of Study Design	Late September 2005
Existing conditions characterization	January 2006
First series of PIC's/workshops	May 2006
Second series of PIC's/workshops	September 2006
Submission of Draft Master Drainage Plan Report	November 2006
Submission of Final Master Drainage Plan Report (following reviews)	December 2006

8 QUALITY SYSTEM

The consultant shall outline the measures that it has in place to ensure the quality of the deliverables and that they meet the requirements of this Terms of Reference and the needs of the [redacted]

9 STUDY ADMINISTRATION

[redacted] responsible for day to day contact and regular liaison with the consultant and external stakeholders on behalf of the [redacted] for this study. [redacted] is the [redacted] Project Manager responsible for the coordination of all studies (including this study) currently being undertaken in the [redacted] The Project Team will consist of [redacted] and consultant staff involved directly or indirectly in the study.

The consultant will allow for meetings with the [redacted] Project Manager and the Project Team, at key intervals as appropriate, at [redacted] offices. The consultant will be responsible for preparing the agendas and minutes and any other materials required for these meetings. The number of meetings will be based on the schedule specified in the proposal.

The consultant shall prepare monthly status reports for the [redacted] Project Manager noting, as a minimum, the activities during the preceding month, the activities planned for the coming month, the status of the

budget and any issues requiring input from the [redacted] external agencies. These will be submitted within the first 10 working days of the month, together with an updated schedule.

Individual meetings with regulatory agencies and stakeholder groups, including Conservation Authorities, the development community and residents groups, shall be held as needed to discuss and address any issues that may raise. The consultant should budget for a total of 2 such meetings.

The consultant shall prepare and make a presentation to [redacted] Committee upon submission of the final Master Plan Report.

10 PROPOSAL INSTRUCTIONS

10.1 COST PROPOSAL

The maximum budget for engineering services for the completion of this study is $100,000 (excluding GST). The consultant shall submit with his/her proposal a cost breakdown by major deliverables. Hourly rates for key personnel and support team members shall be provided. As this is a roster assignment, hourly rates must be the same as those submitted in the consultant's roster proposal. These shall be effective for the duration of the project.

Invoices may be submitted on a monthly basis. They should include documentation on the percent complete for each of the major deliverables.

A person-hours matrix including fees shall be submitted, identifying the tasks included in the proposed work plan and schedule, associated staff and their time to complete each task, disbursements, and the total cost for each task (excluding GST). Include all other applicable taxes. Provide an overall total hours and fees for the entire project as well as the total hours and fees for each member of the team.

10.2 TECHNICAL PROPOSAL

Technical proposals should contain the following sections:

- Transmittal Letter;
- Introduction;
- Project Team and Key Personnel – identify key personnel, provide a brief description of experience, their guaranteed availability and role in this assignment;
- Project Understanding and Approach – description of the tasks in the proposed work plan to complete the assignment, approach to public consultant, project management approach and QA/QC program;
- Schedule – provide a proposed schedule in Microsoft Project format to complete the tasks in the proposed work plan as well as a person-hours matrix without fees, outlining the hours each team member has allocated to each of the tasks in the proposed work plan;

Appendices

Maps of study area(s)

APPENDIX S
Niagara Peninsula Conservation Authority Approved Plant Species List

Common Plant Name (*Latin Name for ordering purposes)*	
Poplar, Largetooth aspen	(*Populus grandidentata*)
Poplar, Trembling aspen	(*Populus tremuloides*)
Prickly ash	(*Zanthoxylum americanum*)
Raspberry, Blackcap	(*Rubus allegheniensis*)
Raspberry, Dewberry	(*Rubus flagellaris*)
Raspberry, Purple flowering	(*Rubus odoratus)*
Raspberry, Wild black	(*Rubus occidentalis*)
Raspberry, Wild red	(*Rubus idaeus/ strigosus*)
Redbud	(*Cercis canadensis*)
Rose, Prickly wild	(*Rosa acicularis*)
Rose, Smooth wild	(*Rosa blanda*)
Rose, Pasture	(*Rosa carolina*)
Rose, Swamp	(*Rosa palustris*)
Rose, Prairie	(*Rosa setigera*)
Sassafras	(*Sassafras albidum)*
Serviceberry	(*Amelanchier spp.)*
Shrubby cinquefoil	(*Poentilla fruticosa*)
Snowberry	(*Symphoricarpos alvus v. albus*)
Spicebush	(*Lindera benzoin)*
Spruce, Black	(*Picea mariana*)
Spruce, White	(*Picea glauca*)
St. John's wort, Kalms	(*Hypericum kamianum*)
St. John's wort, Shrubby	(*Hypericum prolificuam*)
Steeplebush	(*Spiraea tomentosa*)
Sumach, Fragrant	(*Rhus aromatica*)
Sumach, Shining	(*Rhus copallina*)
Sumach, Smooth	(*Rhus glabra*)

Common Plant Name (*Latin Name for ordering purposes)*	
Sumach, Staghorn	(*Rhus typhina*)
Sweetfern	(*Comptonia peregrina*)
Sycamore	(*Platanus occidentalis*)
Tamarack (larch)	*(Larix laricina)*
Thicket creeper	*(Parthenocissus vitacea)*
Tulip tree	(*Liriodendron tulipifera*)
Viburnum, American cranberry	(*Viburnum trilobum*)
Viburnum, Downy arrow-wood	(*Virburnum rafinesquianum*)
Viburnum, Maple-leaved	(*Viburnum acerfolium*)
Viburnum, Nannyberry	(*Virburnum lentago*)
Viburnum, Withe-rod	(*Viburnum cassinoides*)
Walnut, Black	(*Juglans nigra*)
Walnut, Butternut	(*Juglans cinerea*)
Wild crabapple	(*Malus coronaria*)
Willows	(*Salix spp.*)
Winterberry holly	(*Ilex verticillata*)
Wintergreen	(*Gaultheria hispidula*)
Witch-hazel	(*Hamamelis virginiana*)

For more information on plant site requirements contact NPCA at (905) 788-3135 ext. 241

* Daigle, Jean-Marc and Donna Havinga. 1996. Restoring Nature's Place. (Schomberg, Ontario: Ecological Outlook Consulting and Ontario Parks Association)

* Regional Municipality of Niagara EEAC Task Force on Tree Conservation. April 26, 2000. Rare Trees Conserving Niagara's Heritage Final Report

NIAGARA PENINSULA CONSERVATION AUTHORITY

250 Thorold Road West, 3rd Floor
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Fax (905) 788-1121

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Native Plants of Niagara

Trees, Shrubs, Vines

Common Plant Name (*Latin Name for ordering purposes)*	
Speckled Alder	(*Alnus rugosa*)
Ash, Black	(*Fraxinus nigra)*
Ash, Blue	(*Graxinus guadrangulata)*
Ash, Red (Green)	(*Fraxinus pennsyvanica)*
Ash , White	(*Fraxinus americana)*
Basswood	(Tilia americana)
Bayberry	(*Myrica pensylvanica*)
Bayberry (sweet gale)	*(Myrica gale*)
Bearberry	(*Arctostaphylos uva-ursi*)
Beech	(*Fagus grandifolia*)
Birch, Paper	(*Betula papyrifera*)
Birch, Yellow or curly	(*Betula allegheniensis*)
Birch, Cherry	(*Betula lenta)*
Black gum	*(Nyssa sylvatica)*
Black huckleberry	(*Gaylussacia baccata*)

Common Plant Name (*Latin Name for ordering purposes)*
Bladdernut (*Staphylea trifoliata*)
Blue-beech or hornbeam (*Carpinus caroliniana*)
Blueberries &cranberries (*Vaccinium spp.*)
Buffaloberry (*Shepherdia canadensis*)
Bush honeysuckle (*Diervilla lonicera*)
Buttonbush (*Cephalanthus occidentalis*)
American Chestnut (*Castanea dentata)*
Black Cherry (*Prunus serotina*)
Choke cherry (*Prunus virginiana*)
Dwarf sand cherry (*Prunus pumila*)
Pin cherry (*Prunus pensylvanica*)
Chokeberry (*Aronia melanocarpa*)
Clematis, Purple (*Clematis occidentalis/ verticillaris*)
Virgin's bower clematis (*Clemais virginiana*)
Cucumber tree (*Magnolia acuminata*)
Currants and gooseberries (*Ribes spp.*)
Dogwood, Alternate-leaved (*Cornus alternifolia*)
Dogwood, Flowering (*Cornus florida*)
Dogwood , Gray (*Cornus racemosa*)
Dogwood, Red osier (*Cornus stolonifera/sericea*)
Dogwood, Rough-leaved (*Cornus drummondii*)
Dogwood, Round-leaved (*Cornus rugosa*)
Dogwood , Silky (*Cornus amomum/ obliqua*)
Cedar, Eastern white (*Thuja occidentalis*)
Common Elderberry (*Sambucus canadensis*)
Eastern Hemlock *(Tsuga canadensis)*

Common Plant Name (*Latin Name for ordering purposes)*
Elder, Red-berried (*Sambucus pubens*)
Elm, Rock or cork (*Ulmus thomasii*)
Elm, Slippery or red (*Ulmus rubra*)
Elm, White or American *(Ulmus americana)*
Grape, Fox (*Vitis labrusca*)
Grape, Riverbank (*Vitis riparia*)
Grape, Summer (*Vitis aestivalis*)
Bristly Greenbrier (*Smilax tamnoides*)
Round-leaved Greenbrier (*Smilax rotundifolia*)
Hackberry (*Celtis occidentalis*)
Hawthorns (*Crataegus spp.- compta conspecta, dissona formosa persimilis* et. al.)
Hazelnut, American (*Corylus americana*)
Hazelnut, Beaked (*Corylus cornuta*)
Hickory, Big shellbark (*Carya laciniosa*)
Hickory, Bitternut (*Carya cordiformis*)
Hickory, Pignut (red) (*Carya glabra/ovalis*)
Shagbark Hickory (*Carya ovata*)
Honey locust (*Gleditsia triacanthos*)
Honeysuckles (*Lonicera spp.*)
Hop tree (*Ptelea trifoliata*)
Ironwood (*Ostrya virginiana*)
Juniper, Common (*Juniperus communis*)
Juniper, Creeping (*Juniper horizontalis*)
Kentucky coffee tree (*Gymnoclaus dioicus*)
Labrador tea (*Ledum groenlandicum*)
Leatherwood (*Dirca palustris*)
Maple, Black (*Acer nigrum*)
Maple, Mountain (*Acer spicatum*)

Common Plant Name (*Latin Name for ordering purposes)*
Maple, Red (*Acer rubrum*)
Maple, Silver (*Acer saccharinum*)
Maple, Sugar (*Acer saccharum*)
Meadowsweet or Wild spireaea (*Spiraea alba*)
Meadowsweet, Broad- leaved (*Spiraea latifolia*)
Moonseed (*Menispermum canadense*)
Mountain holly (*Memopanthus mucronatus*)
Mountain-ash (*Sorbus americana*)
Mulberry, red (Morus rubra)
New Jersey tea (*Ceanothus americanus*)
Ninebark (*Physocarpus opulifolius*)
Oak, Black (*Quercus velutina)*
Oak, Bur (*Quercus macrocarpa*)
Oak, Chinquapin (*Quercus mehlenbergii*)
Oak, Dwarf chestnut (*Quercus prinoides*)
Oak, Hill's (*Quercus ellipsoidalis*)
Oak, Pin (*Quercus palustris*)
Oak, Red (*Quercus rubra*)
Oak, White (*Quercus alba*)
Oak, Swamp, White (*Quercus bicolor*)
Oak, Shumard's (*Quercus shumardii*)
Pawpaw (*Asimina triloba)*
Pine, White (*Pinus strobus*)
Plum, Canada (*Prunus nigra*)
Plum, wild (*Prunus americana*)
Poison ivy (*Rhus radicans*)
Poplar, Balsam (*Populus balsamifera*)
Poplar, Eastern cottonwood (*Populus deltoides*)

Common Plant Name (*Latin Name for ordering*)	
Sedge, Pennsylvania	(*Carex pensylvanica*)
Sedge, Plantain-leaved	(*Carex plantaginea*)
Sedge, Porcupine	(*Carex hystericina*)
Sedge, Retrorse	(*Carex retrorsa*)
Sedge, Woodland	(*Carex blanda*)
Side oats grama	(*Bouteloua curtipendula*)
Slender wheat grass	(*Elymus trachycaulis*)
Solomon's seal	(*Polygonatum biflorum*)
Solomon's seal, False	(*Smilacina racemosa*)
Solomon's seal, Hairy	(*Polygonatum pubescens*)
Solomon's seal, Starry false	(*Smilacina stellata*)
Spotted joe-pye-weed	(*Eupatorium maculatum*)
Squirrel corn	*(Dicentra canadensis)*
Sweet flag	*(Acorus calamus)*
Sweet grass	*(Hierochloe odorata)*
Sweet ox-eye	*(Heliopsis helianthoides)*
Switch grass	*(Panicum virgatum)*
Tall meadow-rue	*(Thalictrum polygamum)*
Tick-trefoil, Pointed-leaved	*(Desmodium glutinosum)*
Tick-trefoil, Showy	*(Desmodium canadense)*
Trillium, Red	*(Trillium erectum)*
Trillium, White	*(Trillium grandflorum)*
Trout-lily, White	*(Erythronium albidum)*
Trout-lily, Yellow	*(Erythronium americanum)*
Vervain, Blue	(*Verbena hastata*)
Vervain, Hoary	(*Verbena stricta*)
Vervain, White	(*Verbena urticifolia*)

Common Plant Name (*Latin Name for ordering*)	
Violets	(*Viola spp.*)
Virginia mountain mint	(*Pycnanthemum virginianum*)
Wild ginger	(*Asarum canadense*)
Water-lily, Fragrant white	*(Nymphaea odorata)*
Water-lily, yellow	*(Nuphar variegatum)*
White beardtongue	*(Penstemon digitalis)*
White turtlehead	*(Chelone glabra)*
Wild bergamot	*(Monarda fistulosa)*
Wild columbine	*(Aquilegia canadensis)*
Wild geranium	*(Geranium maculatum)*
Wild ginger	*(Asarum canadense)*
Wild leek	(*Allium tricoccum*)
Wild rice	(*Zizania spp.)*
Wild rye, Canada	(*Elymus canadensis*)
Wild rye, Riverbank	(*Elymus virginicus*)
Wild senna	(*Cassia hebecarpa*)
Wild strawberry	(*Fragraria viginiana*)
Wild yam	(*Discorea villosa*)
Yellow mardarin	(*Disporum lanuginosum*)

For more information on plant site requirements contact NPCA at (905) 788-3135 ext. 241

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* Regional Municipality of Niagara EEAC Task Force on Tree Conservation. April 26, 2000. Rare Trees Conserving Niagara's Heritage Final Report

NIAGARA PENINSULA CONSERVATION AUTHORITY

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E-mail: npca@conservation-niagara.on.ca

Native Plants of Niagara

Wildflowers and Grasses

Common Plant Name (*Latin Name for ordering*)	
Anemone, Canada	(*Anemone canadensis*)
Anemone, Thimbleweed	(*Anemone cylindrica & virginiana)*
Aster, Arrow-leaved	(*Aster urophyllus /sagittifolius*)
Aster, Flat-topped	(*Aster umbellatus*)
Aster, Hairy	(*Aster pilosus* [incl. *Pringlei*])
Aster, Heart-leaved	(*Aster cordifolius*)
Aster, Heath	(*Aster ericoides*)
Aster, Large-leaved	(*Aster macrophyllus*)
Aster, New England	(*Aster novae-angliae*)
Aster, Panicled	(*Aster simplex*)
Aster, Sky blue	(*Aster oolentangiensis* (*axureus)*)
Aster, Smooth	(*Aster laevis*)
Aster, Swamp	(*Aster puniceus*)
Baneberry, White	(*Actaea pachypoda*)
Beach bean	(*Strophostyles helvola*)
Bee balm or Oswego tea	(*Monard didyma*)

Common Plant Name (*Latin Name for ordering*)
Blazing star, Cylindric (*Liatris cylindracea*)
Blazing star, Dense (*Liastris spicata*)
Blazing star, rough (*Liatris aspera*)
Bloodroot (*Sanguinaria canadensis*)
Blue cohosh (*Caulophyllyum thaclictroides*)
Blue-eyed grass (*Sisyrinchium montanum*)
Bluebead lily (*Clintonia borealis*)
Bluestem, Big (*Andropogon gerardii*)
Bluestem Little (*Andropogon scoparius*)
Bluets (*Hedyotis/Houstonia longifolia*)
Bottlebrush grass (*Elymus hystric (Hystix patula*)
Boneset (*Eupatorium perfalitum*)
Brome, Fringed (*Bromus ciliatlatus*)
Brome, Kalm's (*Bromus kalmii*)
Brome, Tall (*Bromus latiglumis*)
Broomsedge (*Andropogon virginicus)*
Bulrush, American tree-square (Scirpus americana)
Bulrush, Barber-pole sedge (*Scirpus rubrotinctus/ microcarpus))*
Bulrush, Dark (*Scirpus atrovirens*)
Bulrush, Hard-stem (*Scirpus acutus*)
Bulrush, River (*Scirpus fluviatilis*)
Bulrush, Soft-stem (*Scirpus validus)*
Bulrush, Wool grass (*Scirpus cyperinum)*
Bur-reed, Great (*Sparganium eurycarpum*)
Bur-reed, Green (*Sparganium cholocarpum*)
Bush-clover, Hairy (Lespedeza hirta)
Bush-clover, Round-headed (Lespedeza capitata)

Common Plant Name (*Latin Name for ordering*)
Canada bluejoint (Calamagrostis canadensis)
Cardinal flower (*Lobelia cardinalis*)
Cinquefoil, Marsh (*Potentilla palustris*)
Cinquefoil, Silverweed (*Potentialla anserina*)
Coneflower, Black-eyed Susan *(Rudbeckia hirta)*
Coneflower, Green-headed *(Rudbeckia laciniata)*
Cup plant (*Silphium perfoliatum)*
Dogbane, Hemp or Indian hemp *(Apocynum cannibinum)*
Dogbane, Spreading *(Apocynum androsaemifolium)*
Dutchman's breeches *(Dicentra cucullaria)*
Evening primrose *(Oenothera biennis)*
Field mint *(Mentha arvensis)*
Foamflower *(Tiarella cordifolia)*
Fowl meadow grass *(Poa palustris)*
Gentian, Bottle or closed *(Gentian andrewsii)*
Gentian, fringed *(Gentiana crinita)*
Goldenrod, blue-stemmed *(Solidago caesis)*
Goldenrod, gray *(Solidago nemoralis)*
Goldenrod, late *(Solidago gigantea)*
Goldenseal *(Hydrastis canadensis)*
Great blue lobelia *(Lobelia siphilitica)*
Indian grass *(Sorghastrum nutans)*
Ironweed (*Vernonia altissima ; V. gigantea)*
Jack-in-the-pulpit (*Arisaema triphyllum*)
Leafy muhly grass (*Huhlenbergia frondosa*)
Lily, Canada or Michigan *(Lilium canadense /michiganese)*
Lily, Wood (*Lilium phidelhicum)*

Common Plant Name (*Latin Name for ordering*)
Manna grass, Fowl (*Lyceria striata*)
Manna grass, Tall *(Glyceria grandis)*
May apple *(Podophyllum peltatum)*
Milkweed, Butterfly *(Asclepias tuberosa)*
Milkweed, Common *(Asclepias syriaca)*
Milkweed, Swamp *(Asclepias incarnata)*
Milkweed, Whorled *(Asclepias verticillata)*
Monkey flower *(Mimulus ringens)*
Mountain rice, Black-fruited *(Oryzopsis racemosa)*
Mountain rice, Rough leaved *(Oryzopsis asperifolia)*
Obedient-plant; false dragonhead (*Physostegia virginiana)*
Pearly everlasting (*Anaphalis margaritacea*)
Pickerelweed (*Pontederia cordata*)
Pokeweed (*Phytolacca americana*)
Prairie cord grass (*Sparina pectinata*)
Prairie dock (*Siphium terebinthinaceum*)
Praire smoke (*Geum triflorum*)
Purple avens (*Geum rivale*)
Rushes (*Juncus spps*)
Sand dropseed (*Sporobolus cryptandrus*)
Sedge (*Carex normalis*)
Sedge, Awl-fruited (*Carex stipata*)
Sedge, Bebb's (*Carex bebbii*)
Sedge, Bladder (*Carex intemuscens*)
Sedge, Crested (*Carex cristatella*)
Sedge, Fox (*Carex vulpinoidea*)
Sedge, Narrow-headed (Carex stricta)

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APPENDIX T
Municipal By-Law Review

APPENDIX T – CITY BY-LAWS

There is a broad range of municipal by-laws within the Niagara Region and NPCA watersheds that provide protection of stormwater quality and quantity. To ensure consistency across all municipalities the Niagara Region has developed model by-laws, such as a Model Site Alteration By-law and Sewer Use By-law, as a guide for municipalities.

The following is a summary of the municipal by-laws in use within the Niagara Region and NPCA watersheds as well as other jurisdictions. Highlights from the various by-laws has been summarized below that directly or indirectly relate to SWM.

Storm Sewer By-Laws

Pollutants that are discharged into sewers and drains are regulated by Sewer Use By-Laws. The priority of the sewer use by-law is to protect public health and safety as well as protection of the environment. The by-law helps to prevent contaminants from entering drainage systems and ultimately ending up in the environment.

The Town of Fort Erie's by-law to regulate the Management of a System of Sewer Works and Drainage Works has a number of policies specific to stormwater drainage.

Storm Drainage Requirements

Before issuing a building permit, or before the construction of a drain or modification to a drain, the municipality may require the owner to complete one of the following matters:

a) A study of storm water quality and/or quality;
b) Modification and/or construction of storm water facilities;
c) Adoption and implementation of pollution prevention techniques and measures;
d) Adoption of a SWM plan; or
e) Any other requirement as specified by the engineer and council.

Quality of Stormwater Drainage

The *Management of a System of Sewer Works and Drainage Works By-law* for the Town of Fort Erie and *Sewer Use By-law* for the City of St. Catherines provides clear policies on drainage works use restrictions. The policy notes "that no person shall directly or indirectly discharge or deposit, or cause or permit the discharge or deposit of matter of any type in or into the drainage works where to do so may cause or result in impairment of the quality of the water in any well, lake, river, pond, spring, stream, reservoir or other water or watercourse". The policy warns that doing otherwise would be a contravention of the *Ontario Water Resources Act, Environmental Protection Act* and the *Fisheries Act*.

SWM facilities on Private Lands

It is important that private SWM facilities are maintained to ensure effective operation and continual treatment of stormwater.

The Town of Fort Erie's Sewer Use By-law requires that all drainage service connections from multiple residential, commercial, institutional and industrial parking facilities shall be provided with interceptors meeting the MOE's standards for stormwater quality. The policy also requires for a maintenance hole to be maintained in good repair and operating condition for observations, sampling, testing, and measurement of flow. Maintenance of the water quality devices are to be maintained at the owner's expense. Should the owner fail to maintain the interceptor, the Corporation will carry out the required maintenance and expense to the owner or the operator. The other option is to add the maintenance costs to the tax roll of the property owner.

Other municipalities have updated their sewer use by-law to cover on-site water quality control treatment technologies for private lands. The City of Burlington, for example, requires that where installed, all grease, oil and stormwater interceptors, and any other type of stormwater quality control device shall be maintained by the owner of the water quality control device and costs for such maintenance shall be the sole responsibility of the owner of the stormwater quality control device.

The Town of Halton Hills, through the site plan agreement, specifically states that the landowner must maintain the SWM facility as a condition of the legal contract.

The City of Calgary uses 'Private Maintenance Agreements' that ensure that the owner maintains private SWM facilities. If the owner does not maintain the facility to provide the minimum level of service, the City will maintain the facility and bill the owner.

The Town of Oakville requires that quality and quantity control devices shall be located at the property line for municipal access. If access from the property lines is not possible, easements may be required.

The District of Saanich, British Columbia requires maintenance schedules and proof of maintenance provided for all private systems annually. For the first three-years of operation a maintenance bond must be provided to the municipality. After three-years of adequate maintenance, the maintenance bond would be returned to the owner. After the maintenance period, the owner is to continue to monitor and maintain the facility to provide the required level of service. If the owner does not maintain the facility, the municipality shall undertake the works and then bill the owner.

Site Plan Control By-laws

The site plan control by-law gives the municipality the power and authority to designate the municipality as a site plan control area. This means that site plans for new developments and redevelopments must be approved by Council before building permits can be issued. The by-law also allows the municipality to identify areas that are exempt from site plan control. Development types typically subjected to site plan control include industrial, commercial, institutional, and multiple residential units *(i.e.*, in excess of four units). Through the site plan control by-law the municipality will also specify development types exempt from site plan control such as low density residential, additions less than 30 m^2, new dwellings in a plan of subdivision, and agricultural areas.

Municipalities develop site plan control manuals that identify submission requirements for site plan applications for new development and redevelopment. The manual identifies to the developer the requirements and expectations in order to obtain a building permit. Section 1.27 in **Appendix N** provides further information and policy direction regarding site plan control specifically relating to SWM and minimizing the potential impacts of development on water resources.

Downspout Disconnection By-laws

The City of St. Catharine's has a downspout disconnection program that requires homeowners to disconnect downspouts that outlet into sanitary/combined sewer systems. By disconnecting downspout connections to combined sewer systems homeowners are helping to prevent CSOs. During heavy rainfall events, stormwater contributions to the combined sewer system overloads the sanitary system and can result in raw sewage being released untreated into a receiving water body.

The downspouts are disconnected and redirected to pervious surfaces such as lawns or water gardens where the runoff has the opportunity to infiltrate. Downspouts can also be connected to rain barrels and used to store the rainwater for irrigation purposes.

Drainage By-laws

Municipalities are preparing drainage by-laws that address runoff water quality and quantity, and the need for sediment and erosion controls. The by-laws, for example, prohibit the draining of swimming pool and hot tub water directly into storm catch basins. The by-law will also prohibit encroachments such as roof leaders extended beyond property lines into buffers.

The City of Calgary has a drainage by-law where excavation of a parcel has been authorized by the issuance of a building, excavation or other municipal permit, and water may be directed from the site into a storm drainage system. However, the runoff shall be filtered to prevent silt and debris from entering the storm drainage system. The City of Calgary is committed to providing water quality for stormwater runoff and therefore during development and construction of both large and small parcels of land sediment and erosion control is required.

Site Alteration By-laws and Soil Preservation By-laws

The Town of Fort Erie Site Alteration By-Law manages the alteration of the grade of land, the filling or draining of wetlands, the filling of valleylands and woodlots, and topsoil preservation.

This by-law protects areas where there is currently no means for the regulation of issues such as drainage, pre-development land disturbances, golf course development, as well as the protection of topsoil, farmland or environmental areas (however, site alterations that are part of normal farm practices are exempt). The Site Alteration By-law provides not only for the reparation of damages to the land, but it allows for the imposition of fines of up to $25,000 for individual offenses and up to $100,000 for corporate offenses.

Property Standards

The by-law for Niagara on the Lake, City of Thorold, City of Niagara Falls, and City of Port Colborne prescribes the standards for the maintenance and occupancy of property prevents the surface ponding of SWM. By-laws would need to be amended to provide the opportunities to implement at source SWM controls that would require temporary surface ponding.

Snow Disposal By-laws

Snow disposal by-laws consider snowmelt water quality and locations where snow disposal areas are permitted. Groundwater sensitive areas are not good locations for snow dumps and provisions should be made to control melt water from a quality and quantity perspective.

Front Yard Parking By-laws

Municipalities, such as the Town of Richmond Hill, are adopting by-laws that restrict the widening of driveways and reduction in landscaped area. By-laws such as this one are effective at preventing an increase in impervious area.

Pesticide Reduction By-laws

Municipalities should adopt, or up-date existing by-laws to minimize the risk of water quality impacts as a result of pest management to control weeds, insects and diseases. These strategies should include:

- Use of biodegradable pesticides, (herbicides are counted as pesticides);
- Reduction in the use of pesticides through:
    - Aggressive crop growth to compete with weeds;
    - Use of cover crops as biological weed control;
    - Crop rotation;
    - Rotation of pesticides;
    - Selective area applications and maintenance of accurate records;
    - Use of tillage to control weeds;

  - Herbicide application after crop emergence (rather than soil applied);
  - Avoidance of application of herbicides late in season when crop yields will not be affected;
- Reduce pesticide losses:
  - Avoid chemical sprayer loading near wells and surface water;
  - Do not fill sprayer directly from well or surface water source;
  - Protect surface water from spraying (i.e., maintain a buffer strip between field and surface water resource);
  - Avoid spraying prior to heavy rains;
  - Monitor application rates (follow directions closely) and accurately calibrate sprayer;
  - Reduce chemical drift by avoiding spraying if winds are higher than 8 km/h and by using a low spray pressure to produce larger drops or high water volumes (170 l/ha or more).